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A.M.A. ARCHIVES OF OTOLARYNGOLOGY

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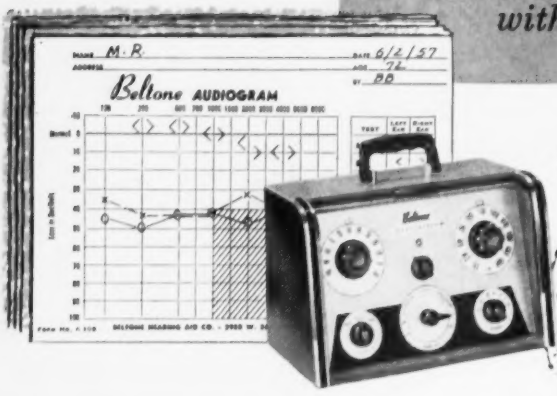

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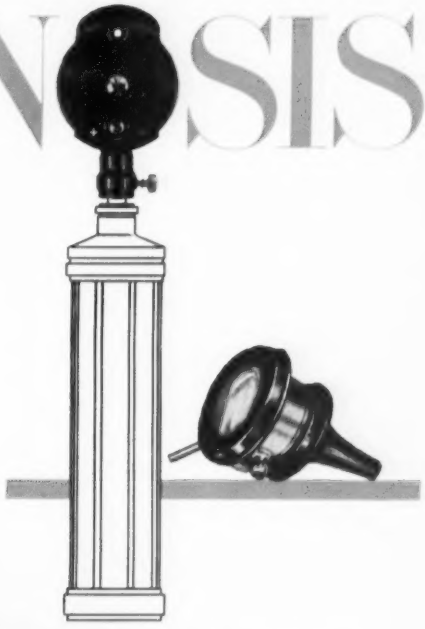

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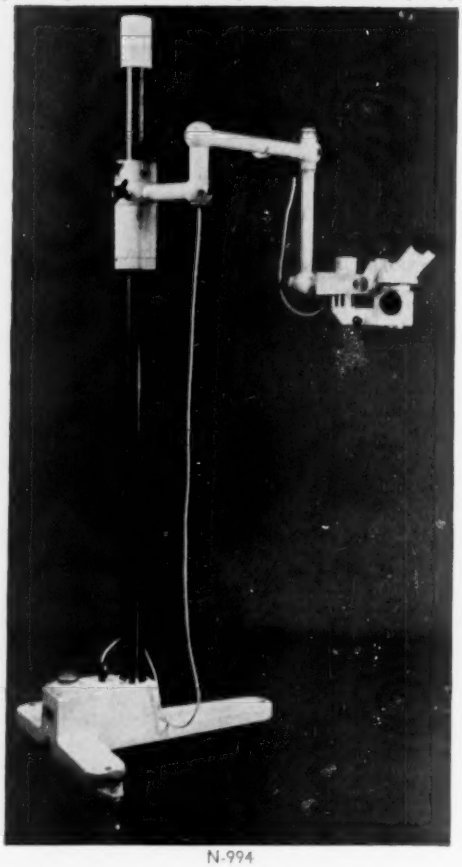

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Adrenal Cortical Influence on Lymphatic Tissue Function

DAVID A. DOLOWITZ, M.D.; THOMAS F. DOUGHERTY, Ph.D.; ROBERT D. HIGGINBOTHAN, Ph.D., and CRICHTON McNEIL, M.D., Salt Lake City

A type of hypogammaglobulinemia is reported in which certain adrenal cortical hormones enhance the release of antibody. Analysis of our 48 cases showed two main types. First, a predominant type found in the hypolymphatic type of person described by Good. Second, a type found in a small number of cases, about 10% of persons with hyperplasia of the lymphoid tissue. The following study attempts to demonstrate that, despite the fact that adrenal cortical hormones are responsible for the inhibition of lymphocyte formation, they may raise the blood level of globulins by clinically significant amounts.

In reviewing the series of hypogammaglobulin cases, we found one report of a mother and a newborn baby, both with marked hypogammaglobulinemia. The child developed pneumonia within the first day of life. The infection did not respond to antibiotics but, on being given gamma globulin, the child recovered promptly. In seeking an explanation of why only one of the two became ill, it occurred to us that the stress of delivery might have provided the mother with enough corticosteroid to release antibody from the lymphoid tissue and give her protection.

With this in mind, the series of hypogammaglobulinemic patients was again reviewed and, of the 48 cases, 5 were found to have visible hyperlymphatic tissue formation. One of these patients, known to have hypogammaglobulinemia, but troubled with constant infections of the upper respiratory tract, was selected for further study. After discovery of the deficiency, the patient had been given intramuscular injections of gamma globulin at intervals of three weeks. As long as this program had been followed, there had been no further illness; however, as soon as it was stopped, infection recurred.

Much of the infection started in the lower pharynx and larynx. In an effort to study the basic difficulties, the area was carefully observed and several small nodules were found at the site of the onset of infection. The patient was taken to surgery and one of the nodules removed (Fig. 1). It demonstrated typical lymphoid tissue with many plasma cells, but without the normal germinal centers usually found. After surgery, the gamma globulin level was taken to see the effect of the stress. As noted on Figure

Accepted for publication April 29, 1957.

Material used in the study was supplied by Schering Corporation.

The theoretical work supported by Grant No. DA-49-007-MD-130, Department of the Army.

Presented at the Meeting of the Pacific Coast Society of Ophthalmology and Otolaryngology, Coronado, Calif., April 10, 1957.

From the Department of Surgery and Anatomy, University of Utah Medical School, The Memorial Medical Center, and The Holy Cross Hospital.

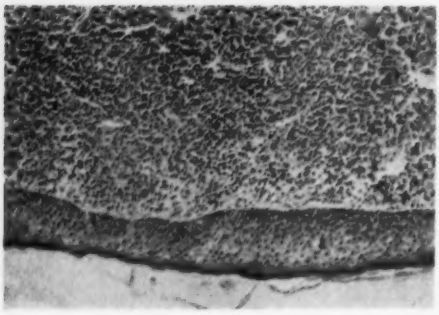

Figure 1

2, it showed an elevation of the blood level in the globulins.

Repeat electrophoresis in three weeks showed that the level had again dropped below normal. In order to see whether our theoretical speculation of stress working through the steroids had caused the elevation, the patient was given 25 mg. of cortisone acetate intramuscularly. Electrophoresis was done at 4, and 24, hours. Within four hours, the gamma globulin was again elevated above normal in the blood levels (Fig. 2). This persisted for 24 hours, and lasted for 3 weeks. The level remained elevated for about three weeks, when it again began to drop. A second injection of cortisone at this time would again restore the level for a three week period.

To be certain that these results were not peculiar to this patient, a second patient was selected with a similar history and deficient gamma-globulin level. Electrophoresis was again taken in 4, and 24, hours. As shown on Figure 3, within four hours the level was

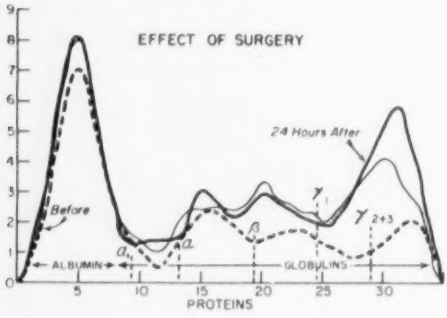

Figure 2

raised to normal, where it remained. It remained at approximately this level for three weeks, when it again began to drop back. Similar findings were found in all five of the cases. Details will not be presented, because of the similarity. In one case a rancher, who was ill with a sore throat for many years, received temporary benefit from antibiotics; however they soon lost their efficacy, or, if they did work, the sore throat returned within a few days after discontinuing antibiotic therapy. After the hypogammaglobulinemia was discovered, he was carried for quite a while with intramuscular injections of the gamma globulin every three weeks. When this became scarce, prednisolone (Meticortelone) was

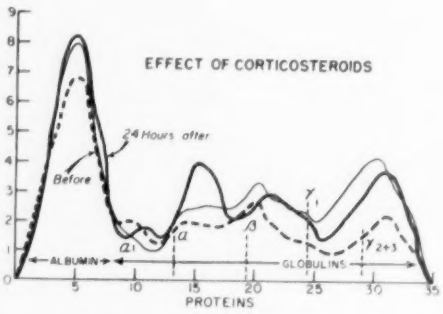

Figure 3

substituted, and he has been carried on an intramuscular treatment of prednisolone every three to four weeks. This material has been given for the past 18 months, his gamma globulin has remained normal during this period, and he has been free of illness.

An attempt was made to reproduce these curves with corticotropin (ACTH) in the place of cortisone. There was no response in the first 24 hours. While it is very possible that a later response may occur, it was felt that clinically it would be inadvisable to follow this approach, as an immediate elevation would be much more important.

Apparently there is nothing new under the sun, for White and Dougherty, and their colleagues, studying the influence of the pituitary adrenal cortical control over lymphoid structures, found that an injection of

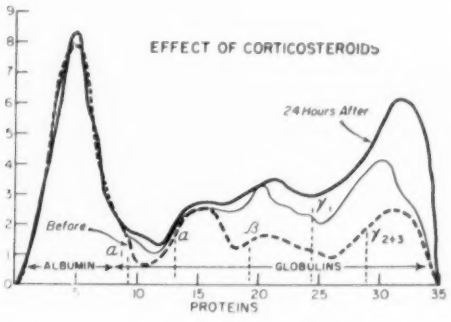

Figure 4

adrenal cortical steroid led to a decrease in the lymphoid tissue. Histologic study, after injection of these hormones, disclosed a dissolution of the lymphocytes with an increase of the immature plasma cells a few hours after the injection. A moderate basophilia in the small lymphocytes suggesting an increase of cytoplasmic nucleoprotein, and an increase in the beta and gamma globulins in the blood level of the treated mice and rabbits were found. White and Doughterty assumed that this was effected through the shedding of the cytoplasm. They also demonstrated, by extraction of these cells, that they contained beta and gamma globulin (shown by electrophoreses) and specific antibody.

On study, they found no antibody in extracted lymphocytes from normal animals, but a great deal of specific antibody was recovered from immunized animals. Study showed that the dissolution of the lymphocytes and the blood antibody increase were at their peak at the same time, corresponding in time with the levels found clinically in the above cases.

From this work, they postulated a hormonal control over the level of circulating lymphocytes with the liberation of antibodies resulting from their dissolution. They felt that the globulin constituent of the cytoplasm apparently passes from cell to cell, as the lymphocytes reproduce themselves. The work was criticized on the basis that other workers could not reproduce these gamma globulin effects with corticotropin, but could repeat them using adrenal cortical preparations (Hammond and Novak). Their opinion coincided with our findings—that the corticotropin given did not produce the same rapid response produced by cortisone.

In summation, it would seem that there are two types of hypogammaglobulinemia: one, most commonly found, in which the lymphoid tissue is hypoactive and, hence, the amount of material to be released is always less than normal, and a second, numerically much smaller type, in which the antibodies are not adequately secreted. It is only in this later group that destruction of the lymphocytes and/or plasma cells liberate sufficient quantity of the antibody to show a rise in blood level of gamma globulin. It is felt that this has substantiated the theory of Dougherty and White, and provides a valuable therapeutic tool for the small group which hitherto have not been helped.

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Acute Osteomyelitis of the Superior Maxilla in an Infant

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Acute osteomyelitis of the superior maxilla as a clinical disease has been known for more than a century. The credit for first describing this condition in infants was given to G. A. Rees (1847), who called it an uncommon abscess in an article in the *London Medical Gazette*. Although this disease carried with it great morbidity and mortality, it did not receive the attention it deserved. Several textbooks on ear, nose, and throat diseases did not describe this condition at all, and those that did devoted very little space to this subject. The case herein presented was examined by the staff of the various specialties, including the ophthalmic, orthopedic, pediatric, dental, general surgery, and E.N.T., and at the first instance all of them failed to diagnose the condition as osteomyelitis. The main reason for missing the diagnosis was, in my opinion, the absence of a description of this condition in many textbooks, and therefore lack of awareness of the clinical disease. It was reported by many authorities that patients with osteomyelitis of the superior maxilla have a mortality rate of 25%-30%. In those cases where there was no mortality, the condition continued for months or years with chronic fistulae. If death occurs during the first 10 days it is attributed to septicemia, and if it occurs later the cause is either bronchopneumonia or brain abscess. Some of the patients probably die of other causes, such as cavernous sinus thrombosis. With the advent of the antibiotics, the chances of recovery definitely became better, and possibly in some of these cases the signs and symptoms are so modified that a definite diagnosis is impossible. A good number of these cases are diagnosed as upper respiratory infection or acute sinusitis; and, if the patient is lucky, the proper antibiotic may be administered early, and in such cases, despite the wrong diagnosis, a cure for the condition may be accomplished by such treatment. As the above condition is most prevalent in the first few weeks of life, it will be appropriate to review the anatomy of the maxilla and the maxillary sinus at this age period. The maxillary sinus is first evident about the 70th day of fetal life. It is primitively a pouching or evagination of the mucous membrane of the floor of the lateral wall of the ethmoidal infundibulum. The sinus is first seen as a slit-like cavity in the membranous lateral wall of the nose. It extends inferiorly into the recess formed by the union of the lateral cartilaginous nasal capsule and the inferior nasal concha. As a result of the expansion of the maxillary sinus sac, the cartilaginous nasal capsule slowly gets thinner and thinner and the maxillary sinus gets bigger and bigger till it occupies a good part of the maxilla. At the time of birth the sinus measures 7 mm. in the ventrodorsal plane and 3-4 mm. in the mediolateral plane. As the mediolateral diameter is small, the shape of the sinus is slit-like, and therefore not clearly delineated in the sinus films. The sinus at this stage closely hugs the lateral wall of the nose. There is no unanimity of opinion regarding the factors that control the growth of the maxillary sinus. Many authors are of the opinion that the deciduous teeth that are closely aligned to the walls of the sinus act as a barrier to the development of the

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sinus. Schaeffer,[21] who did original work on the nasal sinuses, is of the opinion that the dentition has no influence on the development of the sinus. It is reasonable to think that any barrier to the expanding sinus sac may at least slow down the development to some extent. The maxillary sinus at this stage is mostly related to the middle meatus. However, Schaeffer demonstrated that in some cases the sinus may be in closer relationship to the inferior meatus. The rudiments of both deciduous and permanent teeth are already in the maxilla at the time of birth and in close proximity to the walls of the sinus cavity, and it must not be forgotten that any operation in this area is likely to injure these tooth buds, resulting in either deformed teeth or no development of the teeth at all. The composition of the superior maxilla may also throw light on the etiology of the disease. The greater part of the superior maxillary bone is comprised of compact bone, especially around the area covered by the immediate walls of the maxillary sinus. Below this is the spongy-like alveolar medullary bone, and this is the part that has the tooth buds. Probably this area that is covered by the tooth buds has a greater blood supply and, consequently, is liable to infection more frequently. Wilensky[9] pointed out that the arterial supply to the maxilla is by the superior maxillary artery, whose branches form anastomosing loops or arcades; consequently, sequestra are likely to be limited to that area supplied by the loop unless the whole bone forms one big sequestrum. Osteomyelitis is most frequently prevalent in those bones that have bone marrow. The bones of the skull in general are hemopoietic in the early days of infancy. There is no proof that the superior maxilla is hemopoietic in an infant, but such a possibility cannot be ignored. The disease involves the periosteum, the cortex, and the marrow tissues. The disease may spread either by continuity or by the blood stream. It may also spread by a penetrating injury, either by accident or by an operation. The usual organism is Staphylococcus. Less frequently, it may be Streptococcus or Pneumococcus. One authority thought that streptococcal osteomyelitis is twice as common in infants as the staphylococcal. If there is bone marrow in the tissues, an initial violent, acute, exudative inflammation of the marrow tissues take place. The lethal effects of the toxins, together with thrombosis and obliteration of vessels from exudate in the bony spaces, lead at once to necrosis of the marrow and osseous parts. The process soon spreads through the vascularized channels to reach the external surface of the cortex. Thus the periosteum is dissected from the cortex, further impairing the blood supply. Similarly, the infection spreads elsewhere in the medulla of the bone. In this way, a small or large portion of a bone becomes necrotic. If the infection has spread from the nose and caused osteomyelitis of the maxilla, the infection may spread in two ways. The commoner way is by continuity. The infective agent can also travel by way of venous channels in the trabeculated or lamellated bone or in the diploic bone. The mechanism is the formation of phlebitis, with retrograde migration of the infection.

The greatest danger in osteomyelitis is in those cases where the infection is caused by Staphylococcus. Unfortunately, Staphylococcus aureus was the organism that was isolated in almost 100% of the infants with osteomyelitis. The seriousness of this situation is based on the fact that about 80% of the strains of Staphylococcus obtained in hospital wards are resistant to penicillin. Barber et al.[12] did extensive statistical and experimental work in one of the London hospitals and arrived at this conclusion. I had similar experience in the New York hospitals and in Canada. Macbeth,[10] in 1951, reviewed the condition and recommended penicillin therapy and incision of the abscess as the treatment of choice. However, the experience of many others differed. Stuart and Pitt-Steel[5] reported that in their case the organism was sensitive to penicillin in the beginning but was only slightly sensitive later. The patient did not improve after 10 days of intensive penicillin treatment, i.e., 100,000 units q.q.h., and soon after discon-

tinuation of the above therapy the symptoms reappeared. The patient was given chloramphenicol (Chloromycetin) thereafter and two operations were performed—exploration of the antrum on the affected side and radical antrostomy (Caldwell-Luc)—and only after removal of the sequestrum did the condition start to improve. In a case reported by Leonard Haas [4] the patient had osteomyelitis of the maxilla complicated by cavernous sinus thrombosis. The patient received penicillin for four days before it was found out that the organism was not sensitive to penicillin, and medication was then changed to chlortetracycline and streptomycin sulfate. In the meantime, the infection had spread to the cavernous sinus. This case is another example illustrating the need for institution of antibiotics other than penicillin at an early stage of the disease. Early administration of antibiotics may help in preventing the spread of osteomyelitis and, probably, formation of sequestrum or an abscess. Otherwise, when the condition has advanced this far it is doubtful whether any purely medical regimen can avert an operation. Sir William Kelsey Fry, who has had experience in the undernourished communities of Singapore, raised the point that malnutrition is a contributory factor in the development of osteomyelitis. This factor, one may say, plays a part in starting any infection. He also concluded that since the advent of antibiotics the mortality rate has declined. Sir Fry also pointed out that the floor of the antrum, which is formed by the alveolar bone, has a very thin layer of compact bone, only a little thicker than the wall of the cancellous spaces of the alveolar bone itself. It is similar to that found surrounding the healthy tooth socket, which is nothing more than the wall of the cancellous spaces spread out in a line and is seen in x-ray as a white line. Microscopic findings in the normal maxilla show that the bony floor of the antrum is not always continuous; it is not only pierced by vessels but sometimes shows broad interruptions, so that the periodontal membrane of the neighboring teeth comes directly in contact with the mucosa of the antrum.

The clinical pattern of osteomyelitis of the maxilla usually takes a definite course. The patient is aged anywhere between a few days and a few weeks. The symptoms vary, depending on the stage at which the patient is brought to the physician. If the patient was not given any treatment prior to the examination, the patient may have pyrexia of some degree. The patient looks ill, and shows swelling and redness over the inner canthus of the eye. There may be swelling of the lids with edema. At this stage, the condition may be wrongly diagnosed as either orbital cellulitis or dacryocystitis. If there is exudate in the nose, which is not unusual in infants or young children, the condition may be mistaken as upper respiratory infection, acute sinusitis, or ethmoiditis. If valuable time is lost in administering symptomatic treatment with nose drops, etc., the condition advances under the care of the physician and the deciduous teeth begin showing, with swelling of the alveolar margin of the maxilla. Later, the teeth may exfoliate and sinus tracts are formed. Also, one typical early finding is the formation of a sinus tract medial to the inner canthus of the eye. When once these tracts are formed, it may be presumed that the condition has sufficiently advanced that any amount of antibiotic therapy is not going to cure the condition completely. In addition to pus, these sinuses may exude small fragments of sequestra. The greater the delay in controlling the disease by an operation, the greater the number of teeth exfoliated and, consequently, the greater the number of sinus tracts formed. The floor of the hard palate may show swelling and, in some instances, the pus may break through here. Some authors described closure of the eyelids with chemosis of the bulbar and palpebral conjunctiva. Also, they observed proptosis, with displacement of the eyeball, producing ophthalmoplegia. Regarding the mode of infection, despite the recognition of this clinical condition for more than a century, we are still in the stage of conjecture. Blood

is believed to be a source of infection. The entry of the organism may be practically anywhere. As the condition is seen a few days after birth, birth injuries, due either to the use of instruments at the time of delivery or to compression in the genital tract, are considered as possible sources of infection. Cracked or ulcerated nipples are blamed in some instances. Another possible source is an abrasion created in the alveolar margin of the maxilla as a result of using mouth suckers or of the vigorous cleaning of the mouth by an overly conscientious nurse or mother. This could be the primary source of infection, and the organisms spread without much notice. Because of the rich blood supply that is found in this area, the infection, both by continuity and/or by the blood stream, may slowly work its way into the periodontal region. Exudate formation takes place, and this creates pressure and pushes the dead tooth buds out. These show up as premature teeth that are loose, and they fall out. Depending on the virulence of the organism, the infection spreads, and the pus may break through the bone at practically any point, including the infratemporal region, the pterygoid fossa, or the retro-orbital region. If this happens, the condition of osteomyelitis of the maxilla is further complicated by such a spread of infection. The infection can easily spread from the maxillary bone into the maxillary sinus at any time, and this gives the characteristic unilateral nasal discharge. Such a discharge should not be mistaken as a sign of sinus infection and treated as such, because the maxillary sinus is so small, as was described above, that it is not capable of being primarily involved. While the above is the most probable mode of spread of the disease, there are other sites from which the disease may spread. Lederer's case is an example of this. In a 3-week-old infant who died of osteomyelitis of the maxilla and cavernous sinus thrombosis, Lederer performed an autopsy and proved, beyond a doubt, by serial sections that the infection originated in the inferior ethmoturbinate. However, this mode of spread of infection is comparatively rare in comparison with that through the alveolus. Ballenger classified two stages in the development of the disease. The first stage he called the "septicemic stage," which lasted for 10 days. During this stage, the acute symptoms are persistent and fistula formation takes place. This is followed by a second stage, what Ballenger called the "indolent chronic stage," with persistent fistulae and sequestration which may last for several months. He warned that drainage of the swelling should not be resorted to through the cheek. As a result of the formation of pus in the maxillary bone which tends to break through, there is pressure in the bone, and as a result of pressure the lateral wall of the nasal fossa, which includes the middle and inferior ethmoturbinates, is pushed into the nose medially toward the nasal septum. It is reasonable to assume that pus will be found in the middle meatus only in those cases where the antrum is involved and there is pus exuding through the normal ostium. Even if the antrum is involved, pus may break through the medial wall and drain directly into the inferior meatus. This is even more probable in those cases described by Schaeffer where the slit-like maxillary antrum is in closer approximation to the inferior meatus than the middle meatus. This may mislead the clinician who finds the fistula inner to the inner canthus of the eye in diagnosing the disease as dacryocystitis, as the lacrimal duct opens into the inferior meatus. Although the pathology is generally that described above, in some instances the question arises whether maxillary sinusitis could produce osteomyelitis of the maxilla. McCash and Rowe[8] refute such a possibility. Their argument is based on the theory that nasal discharge must precede swelling of the cheek and formation of fistulae in the alveolus. One cannot rely on these physical signs altogether because the patient may not be seen by the physician till the condition is sufficiently advanced, and it is not possible to know definitely which condition started first. However, we can agree with these authors that the cases that start with acute anthritis and

develop into osteomyelitis are few. The danger of such a development is greater in those cases that were described by Sir William Kelsey Fry. He found in his microscopic observations of the superior maxillae that the bony floor of the antrum, even in normal cases, is not always continuous; it not only is pierced by vessels but sometimes shows dehiscences, so that the periodontal membrane of the neighboring teeth comes directly in contact with the mucosa of the antrum. If this is true, it explains the possibility of spread of the infection from the antrum into the periodontal membrane and into the maxilla.

Treatment

As the condition is acute, proper antibiotic therapy must be instituted at the earliest possible moment. As it is well established by now that most strains of staphylococci are resistant to penicillin, one should not lose time in using this drug. The pus must be taken for culture and sensitivity tests soon after the patient's admission to the hospital, and a broad-spectrum antibiotic or a combination of antibiotics must be administered. Nasal decongestants may help in effecting better drainage but do not contribute significantly in the treatment. The patient must be watched carefully, and a local antibiotic in the form of an ointment may help in either prevention or as a treatment of conjunctivitis. Conjunctivitis is usually caused by contamination of the conjunctiva by the pus that was exuding from the sinus near the inner canthus. The mother must be examined for any possible source of infection, especially the nipples, and if any infection is found, this must be corrected before the infant is permitted to be breast-fed, and in the intermittent period the infant must be bottle-fed on a suitable formula. The loose teeth, if they are in danger of falling out, must be removed. Under no circumstances should drainage be established through the face, as this not only results in an ugly scar but does not help in eradicating the disease process. Supportive treatment such as blood transfusions or infusions helps in building up the patient. Soon after the acute symptoms subside an early operation on the superior maxilla through the gingival approach (as in the Caldwell-Luc operation) should be done under general anesthesia. The diseased bone, sequestrum, and the diseased tooth buds must be removed. Exenteration of all the fistulous tracks must be done, and after removal of the granulations, an antrotomy opening is made in the inferior meatus and the wound is packed with petrolatum (Vaseline)-impregnated gauze. This is retained for two or three days, and daily removal of the drain is done by degrees. The antibiotic should be continued till all the fistulae are cleared up, the infection is completely controlled, and the wound has completely healed.

Report of Case

A 14-day-old Puerto Rican baby girl was admitted to the pediatric service of St. Luke's Hospital on Sept. 22, 1955. The patient was first seen in the hospital emergency room on the 19th of the same month. The history at that time was that the infant had an inflamed left eye for one day. Examination revealed edema of the lower eyelid and blepharospasm. The conjunctiva was injected and covered by purulent exudate. At this stage, diagnosis of conjunctivitis was made and the patient received local application of chlortetracycline (Aureomycin) ophthalmic ointment and was referred to the eye clinic. The same day the patient was next examined by an eye specialist, who diagnosed the case as acute dacryocystitis and referred the patient to the pediatric clinic for a general check-up and the administration of the proper antibiotic. The patient was given 100,000 units of procaine penicillin G a day for three days. During this period, the temperature of the patient fluctuated between 101 and 102.2 F.

The patient was born in a city hospital and the delivery was normal, and there was no other trouble prior to the present complaint. On admission to the hospital, purulent discharge was noticed in the left side of the nasal fossa. The left cheek was red and swollen. In addition, the left upper alveolar arch was swollen and pus was found exuding through a small fistula into the vestibule of the mouth. A small nipple-like projection was seen on the skin medial to the inner canthus of the eye.

The urinalysis was entirely normal. The blood showed a hemoglobin content of 15.4 gm/100 cc., a

R. B. C. of 5,160,000 per cubic millimeter, and a W. B. C. of 12,000 per cubic millimeter. During the hospital stay of the patient, the hemoglobin content fell steadily, presumably as a result of toxicity and/or hemolysis, to 9.4 gm/100 cc. on Nov. 2, 1955.

During the first week, culture of the pus from the nose revealed hemolytic Staphylococcus, coagulase-positive. The organism was sensitive to chloramphenicol and erythromycin and resistant to most of the other antibiotics. With the other clinical findings, the diagnosis was variously made as conjunctivitis, dacryocystitis, gum abscess, and acute maxillary sinusitis by the various examiners.

A series of x-rays of the facial bones and nasal sinuses were taken, but these failed to throw further light in establishing the diagnosis.

On Oct. 3, 1955, one of the deciduous molars that was exfoliating was removed.

The patient was seen by me on Oct. 25, 1955, i. e., a month after admission to the hospital. The patient was afebrile at this time; the left lower eyelid was red and swollen, and there was exudate in the left nasal fossa and pus draining in the left upper alveolus. The punctum of the dacryal cyst was open, and the cyst was not infected. The movement of the eye was normal. There was no evidence of pain or tenderness over the area. The inferior turbinate on the left side appeared to be pushed medially toward the septum. The sinus in the left upper alveolus was lined by granulations. The preauricular and the jugular chain of deep cervical lymph nodes were enlarged but not tender. The small nipple-like elevation medial to the inner canthus burst during this period and alternately exuded pus and closed every few days. The left cheek revealed a moderate amount of swelling, with induration of the skin of the lower eyelid. The above findings were adequate to make a clinical diagnosis of subacute or chronic osteomyelitis of the superior maxilla. It was felt that there was a considerable amount of bone destruction. A well-planned exploration of the maxilla for drainage of the pus and removal of the necrotic bone was considered the proper procedure for treatment. While involvement of the maxillary sinus mucosa was considered, it was felt that such an involvement was secondary to bone disease and was considered clinically nonsignificant.

While the above regimen was under consideration, a surgeon who saw the patient on consultation

Fig. 1.—The small scar inner to the inner canthus of the eye represents the original site of the fistula. The larger scar under the lower eyelid represents the incision that a general surgeon made to expel the pus. The photograph was taken a few days prior to discharge of the patient from the hospital.

Fig. 2.—The photograph was taken to show the irregular formation of the teeth. Three teeth have erupted. One tooth, probably the second or last molar, is seen on the inner aspect of the alveolar process. Photograph was taken six months after the patient's discharge from the hospital.

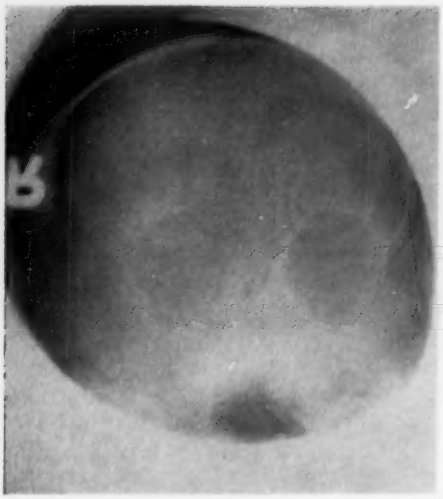


Fig. 3.—X-ray was taken to evaluate the condition of the nasal sinuses. The usefulness of such an x-ray in diagnosis is obviously limited.

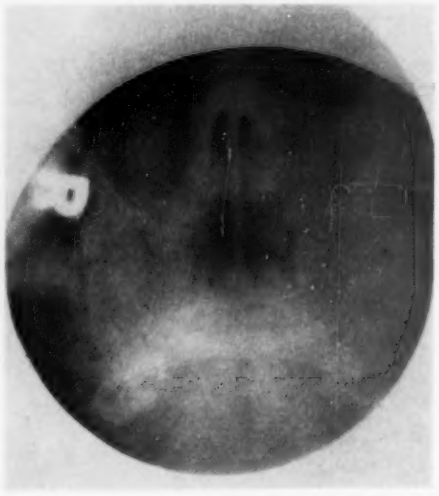
on the same day incised the swelling over the cheek and aspirated 6 to 7 cc. of pus, which was sent for culture studies (Fig. 1). The above procedure left an external opening into the osteomyelitic cavity in a very unfavorable position, hampering drainage. Despite the administration of local and systemic antibiotics, a change of dressing every few hours, keeping a ribbon drainage in the cavity, and irrigation of the cavity twice daily with streptokinase-streptodornase (Varidase), for 10 days, there was no improvement in the local condition.

The patient was operated on Nov. 4, 1955, i. e., six weeks after the onset of the disease. Prior to the day of the operation, 50 cc. of whole blood was transfused into the patient. Operation was done under open ether anesthesia. This was administered through an infant-size Hart ether tube that was passed into the mouth on the right side. Incision was made in the gingivolabial margin (Caldwell-Luc approach). The periosteum was elevated and several small pieces of sequestra and two tooth buds were found lying loose in the bone cavity, and these were removed. The lateral wall of the nasal cavity was found eroded, and the tuberosity of the maxilla was necrotic. There was a moderate amount of granulation tissue diffusing into the incised opening below the eyelid and the fistula created by the exfoliated tooth bud in the alveolar margin. The walls of the fistulae were curetted. The cavity was drained through ribbon gauze inserted through the inferior meatus. The incision was closed with interrupted nonabsorbable surgical (silk) sutures.

Fig. 4.—Preoperative x-ray of the sinuses, showing that the ethmoid sinuses are clear.

The postoperative course was satisfactory. Patient received 100 mg. of erythromycin per day. The nasal packing was removed on the third day. The sutures were removed on the fifth day. Subsequently, one tooth was noticed to be exfoliating at the level of the incisors. Palpation, however, revealed that it was still held firmly in the alveolus, so the tooth was left undisturbed. The patient was discharged from the hospital on the 12th postoperative day in good condition. Follow-up of

Fig. 5.—Postoperative x-ray taken six months after the patient's discharge from the hospital. A defect can be seen in the left maxilla, a result of the operation. Also note the absence of deciduous teeth on the left.



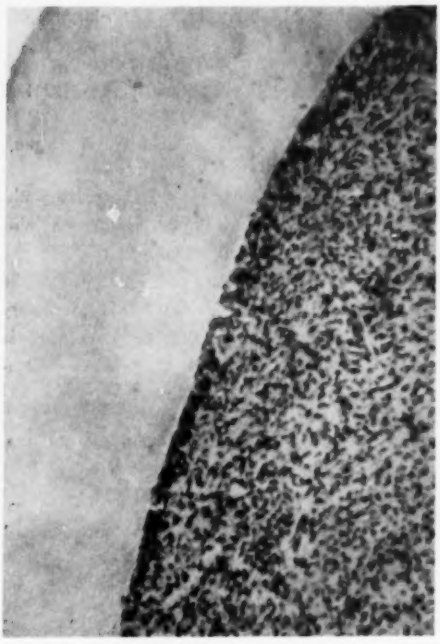


Fig. 6.—Photomicrograph of a deciduous tooth that was prepared after decalcification. The pulp stroma is heavily invaded by chronic inflammatory cells. The central region of pulp shows cells which stain more lightly and appear to be undergoing necrosis. Large numbers of phagocytes have infiltrated the area. The enamel and ameloblast cells appear normal and intact.
Diagnosis: chronic odontitis of the decidual molar.

the patient was in the clinic at weekly intervals, and there was no evidence of recurrence of the disease.

Three months after discharge from the hospital the patient was readmitted for acute purulent otitis media of the left ear, and the pus collected from the ear showed a culture of S. aureus. The infection cleared up in a few days as a result of erythromycin therapy. The patient had three teeth in the left upper alveolus, and their shape was irregular. This was considered a sequela of the disease process (Fig. 2). The fistulae on the face and the alveolus have completely cleared.

Summary

Osteomyelitis of the superior maxilla is a typical clinical disease seen in the first few weeks of infancy.

The organism most commonly found is Staphylococcus aureus, coagulase-positive, often resistant to penicillin.

The surgical anatomy of the superior maxilla in infants is reviewed to explain the pathogenicity of the disease.

Early cultures and sensitivity tests are advocated to determine the need for antibiotic therapy.

A broad-spectrum antibiotic or a combination of antibiotics is advocated early.

It is pointed out that diagnostic x-rays are useless in infants.

A radical operative approach through the mouth is advocated to prevent prolonged morbidity caused by fistulae.

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Glomus Jugulare Tumor with Intracranial Extension

Report of a Case Exhibiting Ossifying Obliterative Labyrinthitis

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Since Rosenwasser[1] described the first clinical case of a carotid body-like tumor in 1945, more than 100 cases have been reported in the literature. It is our purpose to add this case of glomus jugulare tumor because of the unusual findings in the petrous bone.

There will be no attempt made to review the literature. Reference is made to excellent reviews by Winship,[2] Towson,[3] Williams,[4] Stewart,[5] Siekert,[6] and Bickerstaff.[7]

Report of Case

A 53-year-old white woman was referred to the neurosurgery department, of University Hospital, on Feb. 20, 1948, with a diagnosis of "possible angle tumor."

She first sought medical help in September, 1942, when she consulted an otologist because of a pounding type of tinnitus, more intense in the left ear, which had been present for about five years. Otologic examination at that time was entirely normal except for a "slightly dull left tympanic membrane." Audiometric examination showed no change from one taken in 1933 when she had normal hearing. The examiner's opinion was a "slight conductive hearing loss." She returned to the same otologist in May, 1944, with the same complaint—a pulsating tinnitus in the left ear. The examiner's note was, "the Eustachian tubes inflated easily."

The patient's complaints at her initial visit to the University Hospitals in February, 1948, were a gradual loss of hearing in the left ear observed over a period of about 10 years; hoarseness, and difficulty in talking for one year; thickness of the tongue with loss of taste sensation on the left side; a bloody serous discharge from the left ear which had followed the removal of a polyp four months before; a "prickly" sensation of the left side of the face which had been present for from three to four months; "trouble walking straight", and "can hear my heart beat in the left ear—blood wants to come out." Abnormalities noted in the physical examination were a decrease in the gag reflex on the left; atrophy of the left side of the tongue; Romberg's sign positive to the left; slight blurring of the left optic disc; a husky voice; no perception of hearing by air conduction on the left, and the left ear canal filled with a serous discharge. Spinal fluid was normal. X-rays of the skull showed the petrous ridges to be normal, and the internal auditory canals symmetrical. On the pneumoencephalogram there was no space-filling mass evident. A diagnosis of intracranial condition was deferred, and the patient was discharged.

The patient was seen in the otolaryngology department on May 20, 1948. The initial impression was middle ear disease with an aural polyp. X-rays of the mastoids showed active infection in the left. Basal skull films were negative. The very "vascular polyp" in the left auditory canal was removed and the pathological diagnosis was angioma, with the note that further studies were indicated.

On June 15, 1948, she was given radioactive phosphorus (P^{32}) intravenously, in an attempt to decrease the size of the vascular tumor in the left middle ear and the mastoid. The tumor mass, as visualized in the left auditory canal, did decrease in size following this therapy. X-ray studies of the mastoid, however, showed no change, and clinical findings of involvement of the left 8th, 9th, 10th, 11th, and 12th cranial nerves continued.

She was followed as an outpatient. On Feb. 22, 1949, the mass in the left auditory canal had enlarged. The patient complained of a "pressure feeling" in the left ear which was always relieved by incising the mass, with secondary bleeding. Further use of P^{32} was considered but was not prescribed because of the doubtful diagnosis and the anatomic extent of the tumor. Repeated biopsies had shown only granulation tissue.

Surgical exploration of the left mastoid was recommended. The patient was admitted to the University Hospital on July 15, 1949, with a diagnosis of a benign lesion of the temporal bone involving the middle ear and the region of the jugular foramen. A left radical mastoidectomy was performed, with removal of as much as possible of a "very friable and vascular tumor mass" which

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had eroded the floor of the middle ear from the area of the jugular bulb.

Her clinical postoperative course was uneventful. The left middle ear and mastoid cavity remained dry, with no recurrence of the previous tumor mass, until Dec. 21, 1954. The patient returned at that time because of a painless swelling on the left side of the neck, below the angle of the jaw, which had been present for five days. A bruit was heard over this cervical mass, and a bluish tumor mass was again seen in the floor of the left middle ear cavity. Skull x-rays at this time showed a destructive lesion involving the left mastoid process and contiguous floor of the posterior fossa. On Jan. 3, 1955, a neck dissection was done, and a tumor mass, which involved the left jugular vein, removed partially.

The patient received x-ray therapy to the left cervical area following the neck surgery—a total dose of 3,000 r in 12 treatments.

The tumor mass in the left middle ear continued to enlarge, and symptoms of vestibular involvement became more marked.

A second exploratory operation on the left mastoid was performed on July 5, 1955. The entire area was found to be filled with tumor, which could not be removed adequately. The patient died while sleeping the second postoperative day.

Pathological Examination.—Gross Findings: Left side of neck. Old, well-healed scars were observed over the region of the internal jugular vein, and over the mastoid area. At the latter site also a recent surgical wound was present, from which portions of gauze packing protruded. Dissection of the area of previous segmental jugular vein removal showed well-demarcated, rubbery, firm, purplish tumor tissue—about 4 cm. across—between the jugular foramen and internal carotid artery.

Cranial cavity. During removal of the brain, a multilobulated, purplish tumor mass with smooth and glistening surfaces projected from the floor of the left posterior fossa along the brain stem; this was moderately adherent to the latter (Fig. 1*A*). It was severed at its site of dural anchorage, near the left lateral circumference of the foramen magnum. Some lateral lobules of the tumor mass were adherent to neoplastic nodules projecting through the sigmoid sinus dura. The entire left transverse sinus and sigmoid sinus, as well as the posterior half of the superior petrosal sinus, were greatly distended by tumor tissue. Numerous delicately encapsulated, purplish neoplastic nodules —up to 1.5 cm. across—projected through the sinus walls into the posterior and middle cranial fossae. The largest coherent tumor mass was noted along the tentorial insertion on the lateral extent of the temporal ridge and on the distal portion of the transverse sinus (Fig. 1*B*). On reflection of the dura over the posterior fossa, portions of the sigmoid sinus were found to be packed with gauze leading toward the mastoid region. Tumor tissue of the distal sigmoid sinus and the jugular foramen was in continuity with the mass in the neck. A 3 mm. layer of extradural tumor tissue was noted between the jugular foramen and the circumference of the occipital foramen.

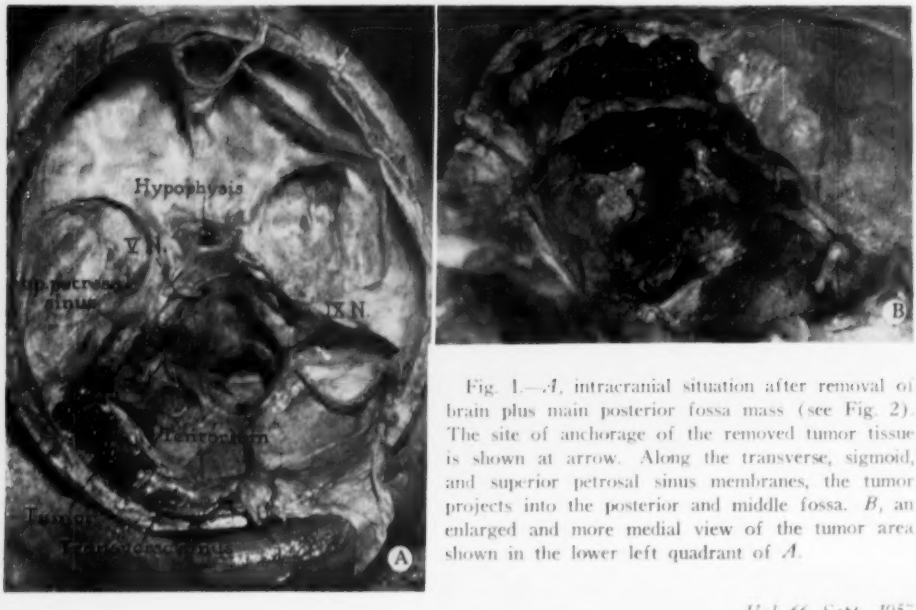

Fig. 1.—*A*, intracranial situation after removal of brain plus main posterior fossa mass (see Fig. 2). The site of anchorage of the removed tumor tissue is shown at arrow. Along the transverse, sigmoid, and superior petrosal sinus membranes, the tumor projects into the posterior and middle fossa. *B*, an enlarged and more medial view of the tumor area shown in the lower left quadrant of *A*.

Fig. 2.—Undersurface of brain, showing distortion of brain stem and cerebellum by tumor mass, also indentations at undersurface of left temporal and occipital lobe.

Brain. The formalin-fixed brain weighed 1,300 gm. Gyri were moderately flattened. Leptomeningeal veins were generally distended, but were especially wide over the pons and left cerebellar hemisphere. The cortical surface of the inferior lateral portions of the left temporo-occipital lobe showed an irregular grooving, with many indentations (Fig. 2). Brain stem and left cerebellar hemisphere were markedly disfigured by the cerebellopontine angle tumor mass, which measured 5.5×4.0×2.3 cm. The lesion could be easily dissected off its bed. There was no evidence of invasion into the brain tissue. Pons and medulla were markedly indented from the left and were pushed over the midline to the right. The pons was also pushed superiorly toward the infundibulum so that neither cerebral peduncles nor mammillary bodies could be seen at the brain surface. The degree of resulting pontine twisting is well demonstrated by the final locations of the fifth nerve exits (Fig. 2.) The left cerebellar hemisphere was so deeply indented that its entire thickness was reduced focally to 7 mm. The middle cerebellar peduncle was markedly atrophic. The left cerebellar tonsil had been pushed posteroinferiorly, between tumor and high cervical cord. The 6th cranial nerve was located at the anteromedial border of the tumor; 7th and 8th nerves could not be identified with certainty; 9th, 10th, and 11th nerves were woven into the tumor capsule over some distance. Left labyrinthian artery and superior cerebellar artery were encased by tumor tissue. Coronal sections through the brain revealed slight widening of lateral and third ventricles, compression of the superior portion of the aqueduct, and presence of a cystic 1.6×2.0 cm. pineal gland. No hemorrhages were found at the brain stem.

Other organs.—The lungs weighed 980 gm. and showed acute congestion. The uterus, excluding the cervix, was absent operatively.

Microscopic findings: Tumor (Fig. 3). The tissue was very cellular and composed of epithelioid cells arranged in clusters between a fibrovascular framework. The tumor cells were of medium size, had indistinct cellular outlines, showed a light-staining somewhat granular cytoplasm, and contained nuclei of moderate chromatin content and great morphological uniformity. No mitoses were seen. On silver impregnation (Fig. 3*B*) a well developed argyrophilic fiber system was demonstrated. Tumor tissue at the venous sinuses was markedly necrotic. The caliber of the capillaries varied greatly; accordingly, some areas of tumor appear solid, others almost cavernous.

Brain. Edema was found mainly at the tegmental portion of the pons. No encephalomalacia or hemorrhage was noted.

Histological Observations of the Petrous Bone

Only the left petrous bone was removed at autopsy and available for study. It was sectioned in series at 25μ. Since much of the tumor had previously been removed from the mastoid, the middle ear, and the lateral sinus region, only the extensions were observed in the sections of the available portion of the petrous bone. In Figure 4*A* the tumor tissue, mixed with granulation tissue containing many congested blood vessels, is shown filling the tympanic cavity in the region of the stapes. In spite of the fact that the stapes footplate is displaced anteriorly (Fig. 4*A* at arrow), the tumor has not invaded the vascular granulation tissue of the damaged annular ligament. The tumor extended into the pneumatic recesses of the middle ear. The fossula of the fenestra cochleae was completely filled with a compact tumor mass which was circumscribed and was in contact with the secondary tympanic membrane; in several places it seems to bulge into eroded pockets of the bone which fills the scala tympani. The tumor was also present at the mouth of the aquaeductus cochleae, but no abnormal tissue was noted in the duct. The same is true of the aquaeductus vestibuli, which was free of tumor cells (*see otic duct*, Fig. 5*A*). Another circumscribed mass extended a short distance into the internal auditory meatus (Figs. 5*A* and *B*) but did not invade the nerve. In the region of the antral air cells the tumor tissue was not so circumscribed but advanced more diffusely into the somewhat edematous and hypertrophied connective tissue of the lining mucosa.

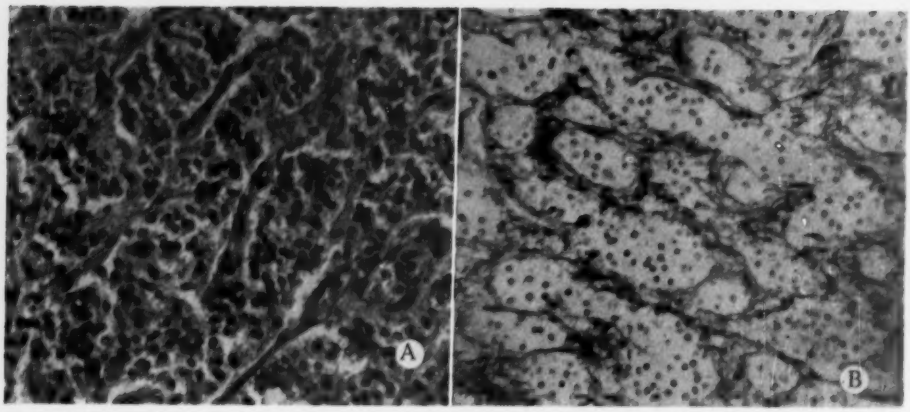

Fig. 3.—Sections of cerebellopontine angle tumor extension. *A*, clusters and columns of "epithelioid" cells, separated from one another by delicate strands of fibrous tissue containing capillaries. Nuclei of tumor tissue remarkably uniform. Hematoxylin and eosin stain; reduced 5/16 from mag. ×400. *B*, rich network of argyrophilic fibers subdividing tumor tissue into small structural units. Modified Bielschowsky stain; reduced 5/16 from mag. ×300.

Fig. 4.—Enlarged photomicrographs of parts of Figure 5*B*. *A*, region of stapes, part of vestibule, and surrounding area. The anterior part of stapes footplate is displaced into the tympanum. The stapes ligament (at arrow) is markedly fibrosed, with a number of enlarged vascular channels. Tumor tissue, present in the tympanum, has not invaded the ruptured stapes ligament or any other part of the internal ear. Several epithelium-lined spaces filled with debris (at *), probably remnants of the otic labyrinth, are shown in the region of the vestibule. The periotic tissue of the vestibule is either fibrotic or osseous. Reduced about 1/9 from mag. × 21. *B*, enlarged view of outlined area in *A*. The epithelium-lined space is probably part of the saccular duct. Note the numerous large chromatophores (a few shown at arrows) in the surrounding connective tissue.

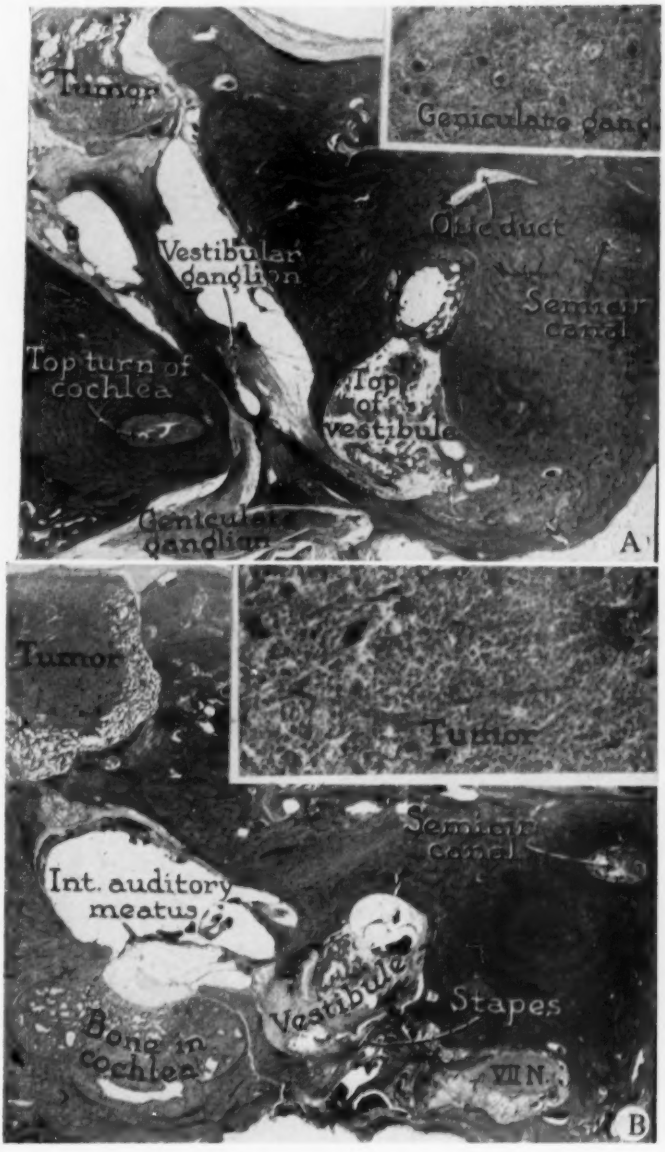

Fig. 5.—Photomicrographs of several sections through left petrous bone. *A*, section through upper part of petrous bone of level of geniculate ganglion and upper parts of internal auditory meatus, cochlea, and vestibule. The only tumor mass seen is at opening of internal auditory meatus. The aquaeductus vestibuli is free of the tumor. The cochlea and semicircular canals are densely filled with bone whereas, in the vestibule the bone is scattered. ×6. The insert at upper right is an enlarged view of the relatively normal-looking geniculate ganglion. Reduced about 1/7 from mag. ×150. *B*, section at level of midcochlea shows large tumor mass below opening of internal auditory meatus. The cochlea, semicircular canal, and vestibule are largely obliterated by new bone. ×6. Insert at upper right, enlarged view of a portion of the tumor. Reduced 1/7 from mag. ×150.

Probably owing to surgery in the mastoid and antral region, some of the tissue seemed to be an admixture of tumor and granulation tissue.

In the apical region of the petrous bone, tumor tissue is diffusely invading the bone marrow. Throughout the bone marrow, the mucosa of the air cells, and all other soft tissue areas, the vascular channels are greatly distended. This is very noticeable along the facial canal (Fig. 6*C*), where the vessels in the facial nerve, the stapedius muscle, and surrounding connective tissue are markedly congested.

In the basal and apical part of the petrous bone there is marked excavation and infiltration of the tumor tissue into the bone marrow spaces. The bone in the floor of the tympanum around the carotid artery also appears cancellous. The tumor is present in the marrow spaces completely surrounding the carotid artery but has not penetrated its wall. The internal carotid artery is widely

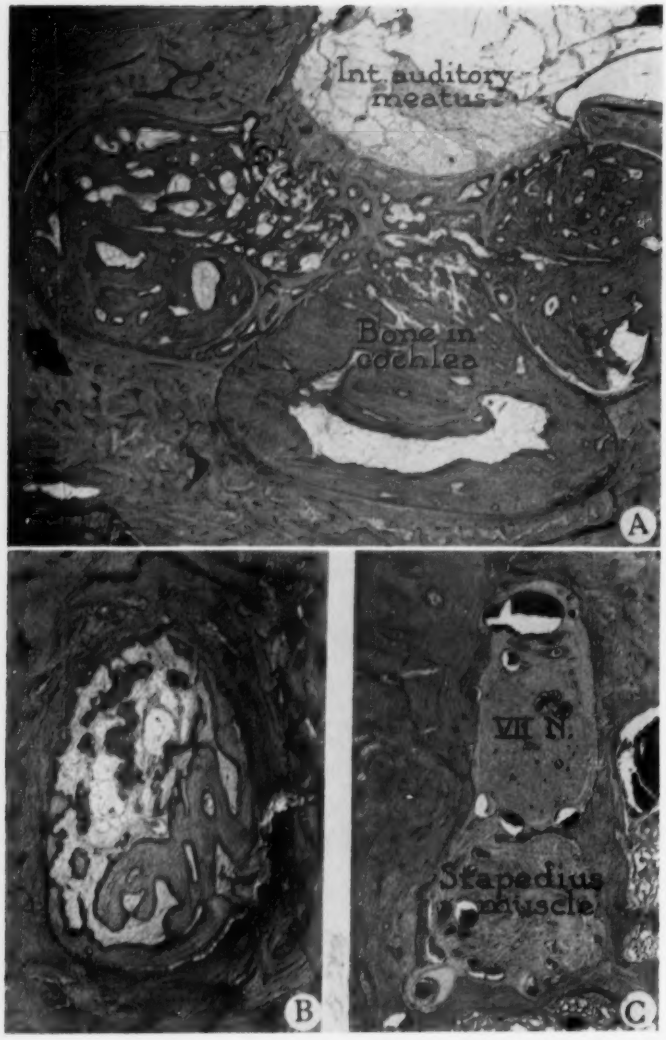

Fig. 6.—Photomicrographs from sections of left petrous bone. *A*, reduced about 1/9 from mag. ×21, and *B*, reduced about 1/9 from mag. ×32, enlarged views of parts of Figure 5*B* showing the bone filling the cochlea and semicircular canal. *C*, engorged vessels in the facial canal and in the stapedius muscle, but no tumor tissue is present.

distended, but its wall seems normal except for a slight thickening of its intima. In spite of the osteoporotic change in much of the petrous bone, the otic capsule has not been altered and has a normal appearance throughout.

The internal ear is of interest for two reasons. First, although the tumor extended to the portals of entry—aquaeductus cochleae, aquaeductus vestibuli, round window, oval window, and internal auditory meatus—it invaded neither any part of the internal ear nor the nerves thereof. It appears as though the otic capsule, the arachnoidal tissue around nervous tissue, and the similar periotic tissue of the internal ear were resistant to the tumor. The vestibular ganglion still contained a few normal-looking nerve cells, whereas the geniculate ganglion was filled with healthy-appearing nerve cells (Fig. 5*A*, insert).

The second point of interest is the almost complete obliteration of the internal ear by intramembranous ossification. In the cochlea and most of the semicircular canals the bone is dense and mature-looking, with fatty bone marrow in its spaces (Figs. 5*A* and 6*A*). In the vestibule and adjacent semicircular canals the bone is more spicular and younger looking, with much surrounding dense fibrous connective tissue (Figs. 4*B* and 4*A*).

The vestibule is not completely filled with bone and a few epithelium-lined spaces of the otic laby-

rinth still are present (see *x* in Fig. 4*A*), and the periotic tissue and spaces are replaced by dense connective tissue. Within this connective tissue a number of engorged vascular spaces can be noted (Fig. 4*A*), and clusters of large chromatophores are scattered throughout it (see arrows in Fig. 4*B*).

Comment

Our case presents the usual clinical characteristics as outlined by Lattes and Waltner.[8] The long duration of symptoms secondary to this slowly growing infiltrative vascular tumor are most striking. Our patient had complaints referable to the area of the left ear for a total of 18 years and, in spite of the extensive cranial nerve involvement, continued to teach school until 3 months before her death.

The high incidence of glomus jugulare tumors in women has been noted. Winship[9] found 85% in a series of sixty-five cases; Siekert[6] reported 22 women in a series of thirty-three cases; Bickerstaff[7] noted an incidence of 4:1 in women. Lewis[10] suggested a possible endocrine relationship. In this connection it is of interest that our patient had had a hysterectomy at the age of 35, following which she was placed on diethylstilbestrol (Stilbestrol) and continued on this medication for many years; the exact duration is not known.

The tumor in our patient involved the left side. The predilection for the left side has been noted in several series of cases studied.[6,7]

The type of treatment given in glomus jugulare tumors varies. Reference is made to the surgical problems involved by Weille and Lane.[11] Crue et al.[12] have advocated ligating the external carotid artery prior to attempted surgical removal of the tumor, in order to lessen hemorrhage and to allow a greater portion of the tumor to be excised. Williams[4] has recommended x-ray therapy to control the progress of the tumor. It is difficult to evaluate any of the various treatments, however, because of the natural slow growth of the tumor and the relatively few cases that have been followed after treatment has been instituted. Our case received a combination of surgery and irradiation. It is the first known case in which radioactive phosphorus (P^{32}) was given intravenously.

Death of our patient resulted from the intracranial spread of the tumor and was presumably enhanced by the postoperative status. No major brain stem lesion such as acute hemorrhage or fresh encephalomalacia were noted. Microscopic findings, however, indicated prolonged preterminal cerebral hypoxia. An upward tentorial herniation and downward occipital herniation of longer standing may have been terminally accentuated by a postoperative stagnation of circulation, and volume increase at the intracranial portion of the tumor. Crue et al.[12] emphasize the sponge-like quality of such a tumor at operation. From our histological examination, the variability of blood volume was very obvious. Internal hydrocephalus—a rare complication of glomus jugulare tumors—was of only slight degree; however, it added a sepratentorial component to the midbrain compression. The latter was enforced, also, on a local level by a pineal cyst which augmented the volume of the gland about two and one-half times.

The biological behavior of the tumor followed the most commonly encountered pattern; although histologically benign, it was locally malignant as evidenced by invasion and destruction of bone tissue and of dural fibrous tissue. Brain tissue in contact with the tumor showed no neoplastic invasion, but pressure atrophy was present. Distant metastases have been encountered in three reported cases according to Crue et al.[12]; we did not discover any on a routine examination of major body organs. The anterior neck region of our patient was free of suspicious-appearing masses externally, making the presence of associated carotid body tumors unlikely; however, a dissection of the sites in question was not performed. Bickerstaff[7] reports co-existent carotid body tumors in 10 of his 90 collected cases of glomus jugulare tumor.

Intracranial spread of glomus jugulare tumors, as evidenced from unilateral paralysis of one or more of the lower cranial nerves other than the eighth nerve, is indicated in 65% of cases by Bickerstaff,[7] and in 40% of cases by Henson et al.[13] In addition to the commonly involved nerves (7th through 12th), in our patient the fifth nerve was found to be affected unilaterally. Bickerstaff[7] lists similar instances in only 10 of his 90 cases. Anatomically, the left trigeminal nerve was not found to be involved directly by the tumor; the paresis apparently occurred secondarily to the displacement of the posterior fossa content. The way of intracranial spreading in our case was predominantly a neoplastic propagation along the dural sinuses, presumably starting in the vicinity of the jugular foramen. This is consistent with the positive x-ray findings of the petrous bone which are demonstrated rather late in the clinical course. The second site of tumor spread into the posterior fossa was also related to the jugular foramen, with a break through the dura close to the foramen magnum.

The ossifying obliterative labyrinthitis is a condition which has received little attention in the more recent literature on the pathology of the ear.

Since the glomus tumor had not invaded the portals of entry to the internal ear, it seems that the obliterating ossification is a process independent of the tumor in question. However, the matter deserves further pathological attention, as both petrous bones are desirable for examination. Ossification of the internal labyrinth was well known to the older otologists. Politzer,[14] in 1887, cited the case of a boy, aged 13, who, at the age of 2½ years, had a severe illness for 14 days, with high fever, convulsions, and deafness. He also reports cases presented by Moos, Kundrat, Burckhard and Merian, and Gradenigo. Ballin[15] stated in 1926 that "from numerous specimens examined we know that epidemic cerebrospinal meningitis terminates in new formation of connective tissue and bone." In support of this statement, he cited cases presented by Schultze, Larsen and Mygind, Moos, Scheibe (1895), Baginsky (1900), Alt and Goerke (1906).

Wittmaack[16] mentions similar cases by Alexander (1906), Manassl (1909 and 1912), and Hellman (1922). In 1951, Tamari et al.[17] reported a case of glomus tumor from which the petrous bone was sectioned. Blood was found in the labyrinth but no ossification was shown. The most recent account by Ballenger and Ballenger[18] includes a photomicrograph from E. W. Hagen's collection illustrating a case of labyrinthitis ossification. Dr. S. R. Guild (in personal correspondence) states that he has several cases recorded in the otological collection in Baltimore.

In all of these cases, the cause of ossification of the labyrinth was ascribed to some infection, usually that of meningitis. It has also been believed that the pathologic process usually occurs in young children and that there is an abrupt onset of the hearing loss.

In the case herein presented some hearing loss was reported to have been noted about 15 years prior to death, probably secondary to middle ear involvement. Total loss of hearing did not occur until much later, when the spiral ganglion was destroyed by the ossifying process. Since all portals of entry to the labyrinth were free from tumor tissue, the cause of the obliterative labyrinthitis must be looked for elsewhere. The only lesion leading to the labyrinth was the break in the anterior part of the stapes ligament. This lesion was well healed with dense but vascular connective tissue. It is possible, therefore, that an infection might have entered at a time when the stapes was dislocated, during any one of the numerous surgical manipulations in the middle ear cavity or mastoid.

Summary

A case of tumor of the glomus jugulare is reported. The tumor was very extensive, involving the neck, middle ear, petrous bone, and part of the left middle and posterior cranial fossae with pressure on the adjacent

brain and 5th, 7th, 8th, 9th, 10th, 11th, and 12th nerves. Although the tumor bulged into the internal auditory meatus, the cells of the geniculate ganglion were mostly intact, but only a scattered number of the vestibular ganglion cells remained. Because of almost complete ossification of the labyrinth, the spiral ganglion was absent. Since the labyrinth was resistant to tumor invasion, the ossification of the labyrinth may be related to a dislocated stapes in the presence of otitis media.

307 Science Hall (6).

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A New Operation for Decompression in Malignant Exophthalmos

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Malignant exophthalmos is a pathological entity. It is also described as exophthalmic ophthalmoplegia, progressive exophthalmos, or thyrotropic exophthalmos.

The last name seems to be most suitable, as it indicates not only the disease but also the presumable cause of this condition.

Symptomatology

The onset is usually insidious. Patients complain of lacrimation, photophobia, and protrusion of the eyeballs, which may achieve extreme grades. There are swelling and inflammation of the conjunctiva, often associated with prolapse of the conjunctival sac. Defective eye closure causes secondary changes in the cornea.

Characteristic are pathological changes in the eye muscles in the form of degeneration of muscle fibers, fragmentation of fibers and round-cell infiltration.

The associated muscle palsies mostly involve the rectus superior on one or both sides with diplopia, or without if both sides are involved. Owing to increased volume of the muscles (3 to 8 times that of the normal volume and length) and the orbital fat, orbital tension increased, possibly causing circulatory disturbances of the optic nerve in the form of defective vision, from blurring to complete blindness.

Etiology

The etiology of malignant exophthalmos is obscure. It is generally believed to be a result of an excess of pituitary hormone.

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There is a strong interrelation between the thyroid and the pituitary gland. Although we have no evidence that thyroxin can produce exophthalmos, it is known that it may cause retraction of the lids. On the other hand, injection of thyrotropic hormone causes exophthalmos in experimental animals. This has been proved by Collip and Anders (1935), Paulson (1939), Aird (1941), and Dobyns (1946) on guinea pigs by injecting thyroid-stimulating hormone of the anterior pituitary gland. (It is believed that the secretion of an "exophthalmos-producing factor" of the pituitary gland leads to protrusion of the eyeballs.)

This experimental exophthalmos persists even when the animal is anesthetized or destroyed, and it appears more pronounced when the experimental animal has been previously thyroidectomized.

Pathology

The cause of proptosis seems to be a direct increase of the orbital contents.

Autopsies show in the case of malignant exophthalmos a remarkable (3 to 8 times) increase of volume of the extraocular muscles. Hermann (1952) speaks of an edematous complex or syndrome. Microscopical examination of the orbital contents shows edema between muscle fibers, their granular degeneration, and fragmentation with lymphocytic infiltration.

Comment

Clinically, malignant exophthalmos is distinct from that observed in Graves' disease, which always is accompanied by systemic evidence of hyperthyroidism and in which the ocular changes are less pronounced.

During a discussion on the management of endocrine exophthalmos at the Royal Society of Medicine, Brain (1951) expressed his opinion based on 150 cases. He regards both diseases, the classical Graves' disease and the malignant exophthalmos, as disturbances of the thyroid-pituitary axis with possible involvement of hypothalamus. The correlation between the thyroid and pituitary glands is well known. Biber (1949, 1951) observed remarkable diminution (up to 50%) of an enlarged thyroid in a case of nanosomia pituitaria after implantation of the anterior part of the pituitary gland or injection of a colloid substance he found in the infundibulum of young cows.

Brain emphasizes that normally there is a balanced relationship between the production of thyroxin and the thyrotropic hormone. In exophthalmic goiter this mechanism should still be working but at a high level for thyroxin production, whereas in malignant exophthalmos the production of the thyrotropic hormone is no longer under control.

This may occur when existing thyroid activity is suddenly suppressed, either by removal of a part of the gland or by medical thyroidectomy (by use of antithyroid drugs), or when the primary stimulus to the pituitary-thyroid axis finds an active pituitary with a relatively irresponsible thyroid.

This would explain the observation that more than 50% of the cases of malignant exophthalmos develop a few months after thyroidectomy for thyrotoxicosis.

According to Mulvany (1939, 1944, 1951), the hyperthyroid complex should be divided into three large groups. In the largest, the condition should be caused by thyrotoxicosis as seen in Graves' disease. Its mechanism is unknown, but it seems to be independent of the thyrotropic activity. There are, rather, signs of hypoactivity of the pituitary gland, as autopsies of persons dying from Graves' disease usually reveal small pituitaries.

There is a small group in which the origin is thyrotropic as physiologically found in pregnancy, and transiently encountered in a menstrual phase. Thyrotropism also is found without hyperthyroidism in the thyrogenous type of myxedema, as opposed to that form of thyroid deficiency resulting from pituitary failure.

Of various forms of hyperthyroidism, two are associated with exophthalmos—namely, the thyrotoxicosis proper and a variety of thyrotropic hyperthyroidism, which may suitably be termed exophthalmic thyrotropism, indicating thereby not only the pathogenesis of the disease, but also the point of its differentiation from other members of the thyrotropic group.

The proptosis of the first group is essentially thyrotoxic, that is, it arises from the combined effects of hyperthyroidism and sympatheticotonia, the two essential components of the disease. On the other hand, the thyrotropic exophthalmos is completely unrelated to any hyperthyroidism with which it may be associated. Its origin depends upon local interaction of the thyrotropic hormone and one other factor, which is evident from the fact that proptosis does not develop in other forms of hyperthyroidism.

The above-cited discussion of Mulvany seems to illustrate in the best way the pathogenesis of malignant exophthalmos.

Treatment

The treatment of malignant exophthalmos causes some problems, especially when the exophthalmos is severe. Many cases respond well to direct thyrotropic control by means of thyroid-iodine administration (large doses of thyroid given for several months). Thus, the output of thyroid-stimulating hormone is inhibited. As the response to this kind of treatment may be expected to be slow, this form of treatment is indicated only in the less severe cases. As 50% of cases develop after thyroidectomy, Hirsch (1950) suggests avoiding, in treatment of

this condition, the so-called medical thyroidectomy (thiouracil).

Pituitary irradiation has proved to be successful in cases where immediate surgical intervention has not been required. It has been recommended by Ginsburg (1939), Means (1944), Mulvany (1944), Mann (1946), and Dobyns (1946, 1950).

Hermann (1952) suggested that irradiation of the anterior pituitary gland be applied as soon as clinical and biochemical data were obtained, and thought that the operation for decompression should be reserved only for patients who show rapidly increasing congestive changes, with edema of the optic disc or deterioration of vision. Twelve of her cases have been treated with irradiation, and only four had to undergo additional operations for decompression due to rapid progress of the process. All cases responded very well to x-ray treatment.

Several operations for decompression have been described. Moore (1920) diminished the orbital contents by removing the orbital fat through an incision along the lower fornix. Hirsch (1929) performed a Caldwell-Luc operation with removal of the orbital floor on both sides along the infraorbital canal, and drainage of the maxillary antrum with the inferior meatus nasi. Naffziger (1931) removed the roof of the orbit after lifting the dura of the frontal lobe. Swift (1935) performed decompression of the orbita by removal of the lateral wall with the zygomatic arch, covering the defect by the temporal muscle. Sewall (1936) removed the lamina papyracea of the ethmoid bone by an external incision. Some of these operations are major procedures. Most of them secure only limited space for decompression, and leave external scars or deformation.

To avoid these disadvantages, a new operation has been performed by me (Fig. 1).

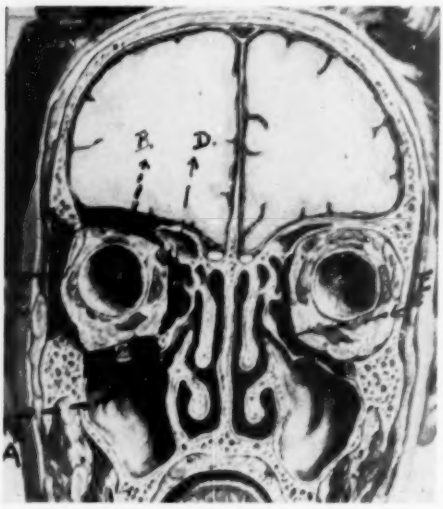

Fig. 1.—Schematic diagram showing various methods of orbital decompression. *A*, Hirsch: removal of the orbital floor by transmaxillary approach. *B*, Naffziger: removal of the orbital roof by intracranial approach. *C*, Swift: removal of the lateral wall by external incision. *D*, Sewall: removal of the lamina papyracea by external approach. *E*, Biber: removal of the orbital floor and lamina papyracea by transmaxillary approach which secures the largest (⅔) decompression of the orbit.

Technique

Under local anesthesia the maxillary antrum is opened in the orthodox way, as in the Caldwell-Luc operation. After topical anesthesia of the antrum mucosa, a large mucoperiosteal flap is formed at the orbital wall with the base facing the posterior wall. The flap is brought down, thus exposing the bony surface of the roof. A window is cut through the bone with a small chisel, medial to the infraorbital canal. The exposed periorbital fascia is lifted and the bone removed toward the articulation with the ethmoid bone by means of ethmoid forceps or punches. The lamina papyracea of the ethmoid bone is extensively removed. (To avoid bleeding from both ethmoid arteries, the respective foramina at the articulation with the frontal bone are guarded.) In this way an extensive bony dehiscence is formed, consisting of most of the orbital surface of the maxillary bone and the lamina papyracea, thus securing a wide space for decompression.

Thereafter the periorbital fascia is split by crucial incision, thus permitting the orbital contents to herniate. The muco-

periosteal flap is put back in its previous position, covering the incision opening. Adhesions which form between the mucoperiosteal flap and the edges of the incised periorbital fascia prevent a possible prolaps of the orbital contents. The flap is supported by a loose packing with ½ in. wide iodoform ribbon gauze, and removed after 24 hours through the sutured mouth incision. As this operation is regarded as a clean plastic operation, no communication with the nose is made.

Abbreviated Report of a Case

A woman, aged 42, had a thyroidectomy performed, after which protrusion of her eyeballs developed, first noted three months after the operation. It seems to have started on the right side; however, it became bilateral in a short period of time. She also noted loss of vision, and complained of diplopia, and swelling and redness of her eyeballs.

Past history showed nothing of significance.

During her first examination (June 3, 1953) the patient was found to have considerable anxiety about her condition. The eyeballs were protruding (measured with Hertl's exophalmometer the protrusion showed equal on both sides, 26 mm.). There was edema of the conjunctiva. The right superior rectus muscle was inactive and the left one was partially so. It caused her to hold the head back to prevent diplopia. The pupils reacted to light and in accommodation; however, the right one was slightly irregular. There were some areas of atrophy of the retina. The tension of eyes was normal.

Laboratory Examination.—Blood and urine insignificant. Mazzini and Kahn tests negative.

Clinical Diagnosis.—Bilateral exophthalmos with paralysis of the right rectus superior and paresis of the left rectus superior secondary to thyroidectomy.

In order to reduce the activity of the thyrotropic hormone, high doses of thyroid preparation were prescribed, combined with strong iodine solution, U. S. P. (Lugol's solution).

Fig. 2.—Preoperative view of the patient.

Fig. 3.—Views taken 10 months postoperatively. Patient's eyes have apparently receded. Right view shows complete closure.

Four months later, increasing protrusion of both eyeballs was noticed. Exophthalmometric reading showed at 97 mm., distance 27 mm. The conservative treatment was prolonged, and the patient showed slight transitory improvement until eight months after the first examination, when the visual acuity suddenly dropped. She was unable to see light in the left eye. The right eye also showed drop of vision—vision being restricted to hand movements only. Exophthalmometric readings showed remarkable protrusion: 29 mm. on the left eye; 27 mm. on the right eye.

The patient agreed to undergo an operation for decompression.

Operation.—With the area under local anesthesia, the left maxillary antrum was opened. A mucoperiosteal flap was formed on the roof of the antrum, thus exposing the bony orbital floor. The orbital plate of the maxilla was removed medially to the infraorbital canal in the direction toward the articulation with the ethmoid bone. The lamina papyracea of the ethmoid bone was removed with punches, and the periorbital fascia split by crucial incision, thus permitting the orbital contents to herniate. Thereafter the mucoperiosteal flap was put back in its previous position and supported by iodoform ribbon gauze. The end of the ribbon gauze was fixed between two stitches after closure of the mouth incision. The same operation was performed on the right side two days later. The after-treatment was satisfactory and uneventful. The patient showed steady improvement of her vision and the protrusion receded.

Ten months after the operation (when last seen) the patient showed remarkable improvement of her vision, and the eyes had apparently receded so that she was able to close them completely. (Fig. 3). In the right eye the vision was 20/200. With the left eye she could count fingers 4 ft. distant. The exophthalmometric reading showed 20.5 mm. on both sides.

In order to hasten the recovery it was suggested that the patient return for irradiation of the pituitary gland.

Summary

The etiology and pathogenesis of malignant exophthalmos are discussed and the value of irradiation of the pituitary gland

emphasized in order to diminish the activity of the thyrotropic hormone.

Different methods of operation for decompression of the orbit are described briefly and a new approach recommended. Simplicity and the ample space for decompression are the main advantages of this operation, and it is agreed with the present generally accepted view that this operation should be reserved for cases with rapid deterioration of vision.

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Presbycusis

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In the past half-century, the number of Americans 65 years of age and older has increased from approximately 3,000,000 to more than 14,000,000 and, it is estimated, will reach 21,000,000 by 1975. This increase does not reflect merely an increase in total population, since our "senior citizens" are becoming a larger proportion of the total population.

The physiologic loss of hearing acuity in older persons brings with it a number of problems. Among these are the difficulties in distinguishing hearing losses due to presbycusis from losses associated with long exposure to intense industrial noise and the psychological disturbances often associated with advanced presbycusis. The frequent inadequacy of present-day hearing aids in the management of deafness due to presbycusis is also an important problem.

These problems have been investigated in a number of ways. Crowe, Guild, and Polvogt,[1] and Schuknecht [2] have studied both animals and humans to correlate certain psychological phenomena with pathological findings in the ears. The Z24-X-2 Committee of The American Standards Association [3] has attempted to give a reasonable estimate of average values for presbycusis in order to allow for this condition in persons with industrial deafness. Large-scale hearing studies held at the New York World's Fair and the San Diego Fair established approximate hearing loss-age relationships. Additional data from the Wisconsin Fair are currently being evaluated. Others have investigated the psychological and communicative problems associated with presbycusis.

In most studies, however, the emphasis has been on persons up to the age of 60 or 65. Little information has been included on older subjects. In an attempt to broaden the study area, the present investigation, therefore, has been devoted to an analysis of pure-tone hearing thresholds on these older persons.

Material and Methods

The subjects in this study consisted of 94 men, aged 64 to 91, and 101 women, aged 64 to 93. The study includes persons of rather diverse backgrounds. Some were private office patients. Some came from private institutions for reasonably well-to-do persons; others came from institutions for rather poor people. One group consisted of men in very good health from a U. S. Naval Home for the Aged; another group had a number of members who were not ambulatory because of arthritis or senility.

Since most of the office patients had primary complaints other than deafness, and hearing tests were often incidental observations, the inclusion of a group of private patients is probably not a source of bias in this instance.

Only subjects who were sufficiently cooperative to give reliable audiograms were considered for inclusion in the study. Prior to each hearing test, a brief history was obtained and an otological examination performed.

Because of language barriers and difficulties in communication with some of the older people, it was necessary to keep at a minimum the number and complexity of the questions asked. Emphasis was placed on age, history of ear infection, dizziness, tinnitus, type of occupation, and exposure to gunfire and industrial noise. When possible, answers were verified through nurses, attendants, physicians, and history charts. It was particularly necessary to verify age from official records, since many women, and an occasional man, understated age by as much as 10 or even 15 years.

It had been decided at the start of the investigation to restrict the study to presbycusis and to

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exclude loss resulting from exposure to significant acoustic trauma. Fortunately, very few persons gave such histories.

Persons with pathological conditions of the middle ear other than the changes normally expected in the senile were excluded, as were those suffering from the common cold or other acute infections likely to have an effect on hearing.

All hearing tests were done by us with the help of a trained assistant. The same calibrated 6BP Western Electric audiometer with double (PDR-10) earphones was used throughout. The calibration of the instrument was checked on several normal ears prior to and after its daily use on subjects in the study.

A standard audiometric technique was used to test each ear separately at all octave frequencies between 256 and 8192 cps, inclusive. At least two, and generally three, consistent thresholds were obtained for 1024 cps and higher frequencies.

The office subjects were tested in a very quiet room (ambient noise level below 35 db.). All others were tested in the quietest rooms available at the various institutions. The highest ambient noise level was 65 db. on the C scale of the sound-level meter, while most of the others were at 55 db. or less, with low frequencies predominating. Hearing tests done on normal ears in the same areas showed no observable effect on threshold for 1024 and higher frequencies. Thresholds at 256 and 512 cycles were sometimes unaffected; when reduced, the loss was at most 15 and 10 db., respectively.

In our study no attempt was made to "correct" measurements at 256 and 512 cycles for ambient noise effect, especially since these people often had subjective difficulty in determining thresholds at these frequencies. Results at the lower frequencies are, therefore, considered less reliable than those at the higher frequencies.

At each frequency, for men and for women separately, threshold loss in the better ear was plotted against age. Curved-line relationships have been reported prior to age 65; that is, in men the loss accelerated with age and in women the loss first accelerated and then decelerated. In the present study, there was no evidence of a curved-line relationship after age 65; hence straight lines were fitted to represent the average relationship of hearing loss to age.

At 8192 cycles, the limit of the audiometer was 80 db. Such a high proportion of subjects had a loss greater than the audiometer could measure that no formal correlation analysis was attempted. Instead the incidence of total loss was determined separately for the younger half and for the older half of the group.

Results

Results of the analysis for 256 to 4096 cycles are presented in Figure 1.

The spread between the top curve and the bottom curve represents the average difference in hearing loss between age 65 and age 90. This difference was fairly constant from frequency to frequency in men, except for the very small value for 4096 cycles. In women, however, there was a significant increase in the spread with increase in frequency. It may be noted that, despite the much greater difference for women than for men at 4096 cycles, men had such a great loss at high frequency by age 65 that both had roughly the same average loss by age 90.

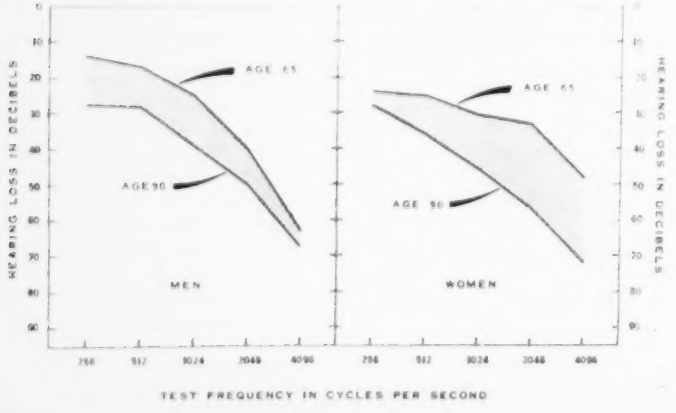

Fig. 1.—Estimated average hearing loss in the better ear, at age 65 and age 90, for men and for women, at test frequencies from 256 to 4096 cps.

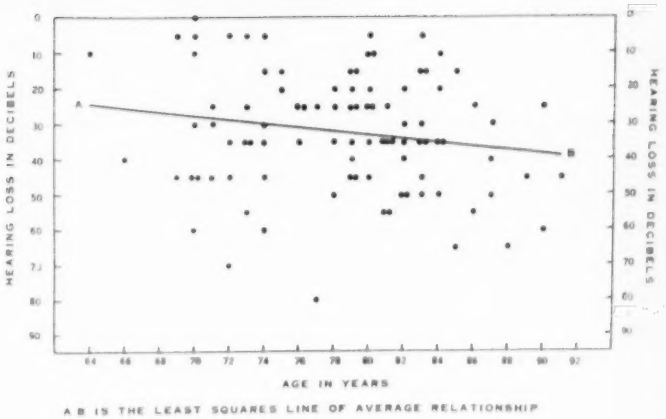

Fig. 2.—Hearing loss in the better ear at 1024 cps in 94 men, aged 64 to 91.

Most of the age 65 to 90 differences in hearing loss were rather small. It should be pointed out that even the few that were rather substantial represent only average differences and tell nothing about individual variation.

As an illustration of the nature of the hearing loss-age relationship, individual hearing losses for men at 1024 cycles are shown in Figure 2. It is apparent from this figure that there is a low correlation between hearing loss and age; that is, past the age of 65 a person's age gives little information concerning his expected hearing loss. It is evident that the variation is appreciable, even at any particular age, with a spread of 50 or 60 db. not at all uncommon.

At 8192 cycles, 60% of the men had no measurable hearing in either ear, while the remaining 40% did have some hearing in at least one ear. These proportions did not vary significantly with age. Only 36% of the women below the median age of 76 had no hearing at 8192 cycles, while 61% aged 76 and over had no hearing. Thus women over 76 seem to have about the same hearing loss as men at this high frequency, while women under 76 years seem to have a smaller hearing loss than men.

The difference between the better ear and the worse ear was in general quite small. At any given frequency, from 256 to 4096 cps, about one-fourth of the subjects had the same hearing loss in both ears and an additional one-third of the subjects had a

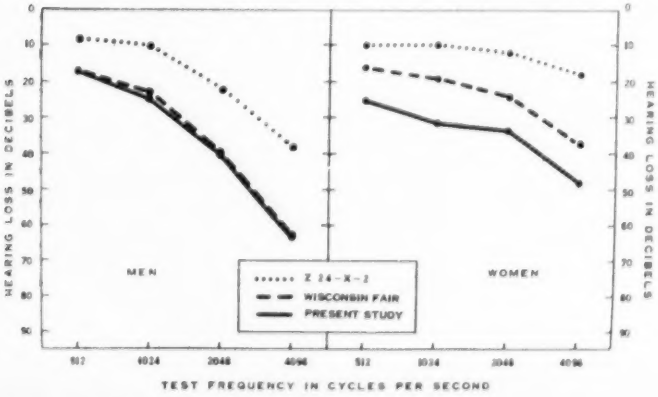

Fig. 3.—Average hearing loss obtained in various studies for men and for women at age 65 at test frequencies from 512 to 4096 cps.

difference of only 5 db. between ears. Roughly three-fourths had a difference of 10 db. or less, and only about 1 in 10 had a difference of 20 db. or more. The greatest difference observed, in the absence of middle-ear disease, was 40 db., but such a large difference was observed rarely.

Comment

Results indicate that little of the variation in hearing loss can be accounted for by age differences after age 65. This is consistent with the thesis that little additional hearing loss takes place after age 65. Before any definite conclusion can be reached, however, individual patients must be followed in long-term studies. Such studies might well disclose that additional hearing loss incurred after age 65 is a function of level of hearing at age 65.

It is of interest to compare average losses at age 65 in the present study with average losses at age 60-69 reported by the Z24-X-2 Committee[3] and by the Wisconsin Fair Group. In Figure 3 values from the present study show considerably greater losses than those reported by the Z24-X-2 Committee; they are quite similar, particularly in men, to those from the Wisconsin Fair.

It should be emphasized that the findings reported in this study are for pure tones only and do not reflect an elderly person's ability to hear and understand speech. Some of these pure-tone losses may possibly reflect primarily epithelial atrophy. Crowe, Guild, and Polvogt,[1] Saxen,[4] and Schuknecht[2] called attention to a "neural atrophy" generally superimposed upon an epithelial atrophy. Pestalozza and Shore,[5] and others, found a lack of agreement between the average hearing loss for pure tones and the threshold for spondees in elderly subjects, as well as severe discrimination losses even with good low-note hearing. Our experience seems to confirm these findings. PB and sometimes even spondee words are frequently heard but not understood even at well above threshold levels. In younger subjects with presbycusis, it is often possible to estimate speech reception loss by averaging the pure-tone losses from 500 to 2000 cycles; in aged patients, such an average may be highly misleading. Separate speech reception and discrimination tests should, therefore, be made in addition to the pure-tone audiogram.

Summary

Threshold losses were measured in 94 men and 101 women between the ages of 64 and 93 who showed no history of significant acoustic trauma or disease.

There was a rather low degree of correlation between hearing loss and age after age 65.

Results were consistent with the thesis that little additional hearing is lost after age 65. Long-term follow-up studies on individual subjects are needed, however, before this can be advanced as a definite conclusion.

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The Topical Temperature of Clinically Normal Nasal and Pharyngeal Mucous Membranes

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The proper preparation of inspired air for acceptable use by the lungs constitutes one of the more important functions of the nasal cavity. Inspired air, during its brief passage through the nasal cavity, is rapidly subjected to a threefold process of cleansing, moistening, and temperature adjustment. In terms of the latter, heating of inspired air depends on an intricate system of blood vessels and cavernous spaces in the turbinal and septal mucous membranes. This vascular network—the blood vessels are described as lying in parallel rows much like a radiator [1]—has the ability to dilate or constrict in response to the need for thermal variations and fluctuations. Actually, a thermostatic apparatus for the efficient heating of inspired air is set into motion when heat is radiated from the blood vessels in the turbinal and septal mucous membranes.

Nasal temperature has been variously estimated to run anywhere from 30 C (86 F) to 36.6 C (97.8 F). Cone [2] reported the normal temperature of the inferior turbinate to be 32 C (89.6 F), while Schutter [3] recorded the temperature of the nose as 33 C (91.4 F). Monti and Gregorini [4] found the nasal temperature of 87 nurses in good health to range from 36 C (96.8 F) to 36.6 C (97.8 F). Traina [5] measured the temperature of the pharynx during nasal inspiration at various atmospheric temperatures. Inspired air at an atmospheric temperature ranging from 0 C (32 F) to 25 C (77 F) produced pharyngeal temperatures running from 36 C (96.8 F) to 36.8 C (98.2 F), while expired air at atmospheric temperatures ranging from 0 C (32 F) to 25 C (77 F) produced pharyngeal temperatures running from 36.2 C (97.1 F) to 37 C (98.6 F).

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Present Investigation

In the present investigation, the topical temperature of clinically normal nasal and pharyngeal mucous membranes was determined in 35 adults (18 men and 17 women). Temperature measurements were taken by the Rauh Surface Pyrometer, a device for making rapid surveys of the mucous membrane and cutaneous temperatures of the human body. The sensing element at the tip of an electrode is connected by a cable to the pyrometer. This element is a thermopile of small mass and responds instantly to changes in temperature on contact with the mucous membranes. The current from the thermopile is recorded by a mirror suspended in such a way as to reflect light on a transparent scale, which can be read either in Centigrade or Fahrenheit. Temperature measurements taken with this instrument must be interpreted, because they are affected by all the variables known to influence mucous membrane and cutaneous temperatures.

The temperature of the nasal mucous membranes fluctuates during respiration, being reduced during inspiration by evaporation, and increased on expiration by warm air from the lungs. Hence, during inhalation, temperature readings were found to fluctuate downward momentarily before a stable, dependable reading could be recorded; during expiration, the reverse was true, with temperature readings fluctuating upward momentarily before registering a stable, dependable reading. To overcome this transient deficiency, patients were instructed to hold their breath momentarily.

Data on the Topical Temperature of Clinically Normal Nasal and Pharyngeal Mucous Membranes in Thirty-Five Adults

Patient	Sex	Nasal Temperature	Pharyngeal Temperature
1	F	Right nasal passage 87.5 F Left nasal passage 88.0 F	91.5 F
2	M	Right nasal passage 91.0 F Left nasal passage 90.5 F	92.5 F
3	M	Right nasal passage 89.5 F Left nasal passage 90.0 F	93.5 F
4	M	Right nasal passage 91.0 F Left nasal passage 91.5 F	93.0 F
5	F	Right nasal passage 86.5 F Left nasal passage 86.0 F	94.5 F
6	M	Right nasal passage 92.0 F Left nasal passage 93.5 F	95.0 F
7	F	Right nasal passage 88.0 F Left nasal passage 89.5 F	91.0 F
8	F	Right nasal passage 88.0 F Left nasal passage 86.0 F	93.0 F
9	M	Right nasal passage 87.0 F Left nasal passage 87.0 F	91.0 F
10	F	Right nasal passage 90.0 F Left nasal passage 89.5 F	94.0 F
11	M	Right nasal passage 89.5 F Left nasal passage 90.5 F	91.5 F
12	M	Right nasal passage 91.0 F Left nasal passage 90.5 F	91.5 F
13	F	Right nasal passage 90.0 F Left nasal passage 88.5 F	90.5 F
14	M	Right nasal passage 91.0 F Left nasal passage 90.5 F	94.0 F
15	F	Right nasal passage 93.0 F Left nasal passage 93.0 F	94.5 F
16	F	Right nasal passage 94.5 F Left nasal passage 94.0 F	95.0 F
17	M	Right nasal passage 91.0 F Left nasal passage 92.5 F	93.0 F
18	M	Right nasal passage 91.5 F Left nasal passage 92.0 F	96.0 F
19	M	Right nasal passage 93.0 F Left nasal passage 93.5 F	94.5 F
20	F	Right nasal passage 89.0 F Left nasal passage 90.5 F	93.5 F
21	M	Right nasal passage 91.0 F Left nasal passage 89.0 F	91.5 F
22	M	Right nasal passage 89.5 F Left nasal passage 90.5 F	92.0 F
23	F	Right nasal passage 88.0 F Left nasal passage 90.0 F	93.0 F
24	F	Right nasal passage 86.5 F Left nasal passage 85.5 F	90.0 F
25	M	Right nasal passage 88.5 F Left nasal passage 90.0 F	92.0 F
26	F	Right nasal passage 89.0 F Left nasal passage 89.0 F	92.5 F
27	M	Right nasal passage 91.5 F Left nasal passage 92.5 F	94.0 F
28	F	Right nasal passage 88.0 F Left nasal passage 87.0 F	91.0 F
29	M	Right nasal passage 89.0 F Left nasal passage 89.5 F	90.5 F
30	M	Right nasal passage 91.0 F Left nasal passage 89.5 F	92.0 F
31	F	Right nasal passage 92.0 F Left nasal passage 93.0 F	95.5 F
32	F	Right nasal passage 90.0 F Left nasal passage 90.5 F	92.5 F
33	M	Right nasal passage 91.0 F Left nasal passage 90.5 F	94.5 F
34	F	Right nasal passage 90.0 F Left nasal passage 90.5 F	92.0 F
35	F	Right nasal passage 88.0 F Left nasal passage 88.5 F	91.5 F

Special efforts were made to avoid excessive pressure by the sensing element when brought into contact with the nasal and pharyngeal mucous membranes. In the case of the nose, the topical temperature of the nasal mucous membranes was obtained by slight contact of the sensing element with the anterior one-third of the inferior turbinate. In the case of the pharyngeal mucous membranes, the topical temperature was obtained by slight contact of the sensing element with the mucous membrane of the supratonsillar region immediately adjacent to the upper pole of the tonsil. Here, too, patients were instructed to hold their breath momentarily, with the mouth partly closed, to avoid distorting the accuracy of the temperature readings, as would be the case during inhalation and expiration. The investigation was conducted at a room temperature that varied slightly, from 70 to 72 F (Table).

In the 18 men studied, the topical temperature of clinically normal nasal mucous membranes was found to range from 87.0 to 93.5 F. In only one subject was the topical temperature of the mucous membranes of the right and left sides of the nasal cavity identical, the remaining 17 men evincing a temperature difference ranging between 0.5 and 2.0 F. In half the subjects, the topical temperature difference between the two sides of the nasal cavity was limited to 0.5 F, while in only one subject was there a difference of 2.0 F. The topical temperature of the pharyngeal mucous membranes of the 18 men was found to range from 90.5 to 96.0 F. In each instance the topical temperature of the pharyngeal mucous membranes was higher than the topical temperature of the nasal mucous membranes. This can be attributed to the warming of the inspired air as it is prepared for acceptance by the lower respiratory tract.

In the 17 women studied, the topical temperature of clinically normal nasal mucous membranes was found to range from 85.5 to 94.5 F. The topical temperature of the mucous membranes of the right and left sides of the nasal cavity was identical in 2 women, the remaining 15 women showing a temperature difference ranging between 0.5 and 2.0 F. Topical temperature difference between the two sides of the nasal cavity was limited to 0.5 F in the case of seven women, while in two subjects there was a difference of 2.0 F.

Among the 17 women studied, the topical temperature of the pharyngeal mucous membranes was found to range from 90.0 to 95.5 F. In each instance, as in the case of the men, the topical temperature of the pharyngeal mucous membranes of women was higher than the topical temperature of the nasal mucous membranes.

Summary and Conclusions

The proper preparation of inspired air for acceptable use by the lungs constitutes one of the more important functions of the nasal cavity. During its brief passage through the nasal cavity, inspired air is subjected to a threefold process of cleansing, moistening, and temperature adjustment. A thermostatic apparatus for the efficient heating of inspired air is set into motion when heat is radiated from the blood vessels in the turbinal and septal mucous membranes.

In the present investigation, the topical temperature of clinically normal nasal and pharyngeal mucous membranes was determined in 35 adults (18 men and 17 women). In the 18 men studied, the topical temperature of nasal mucous membranes was found to range from 87.0 to 93.5 F, while the topical temperature of pharyngeal mucous membranes was found to range from 90.5 to 96.0 F. In the 17 women studied, the topical temperature of nasal mucous membranes was found to range from 85.5 to 94.5 F, while the topical temperature of pharyngeal mucous membranes was found to range from 90.0 to 95.5 F. In both men and women, the topical temperature of clinically normal pharyngeal mucous membranes was higher than the topical temperature of clinically normal nasal mucous membranes.

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Audiology Section

JOSEPH SATALOFF, ASSOCIATE EDITOR

Study of the Repeatability of One Decibel Step Pulsed-Tone Thresholds in Normal Hearing Persons

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In establishing norms for the investigation of certain psychoacoustic functions, it is sometimes desirable to obtain pure-tone measurements in 1 db. steps. Myers and Harris, as well as others,[9] have demonstrated that, under carefully controlled experimental conditions, "the typical short-term fluctuation [i.e., of normal thresholds obtained with steady-state signals] is less than a decibel." The present study was designed to establish whether such findings are also demonstrable when pulsed tones are utilized for the threshold measurement.

Apparatus

A schematic block diagram of the apparatus is shown in the Figure. The various elements in the circuit were shielded from each other by the use of appropriate materials, and the study was conducted under acoustically quiet conditions.

Experimental Circuit.—A General Radio beat-frequency oscillator (Type NO 1304-A) was used to generate the basic sine wave. The output of the oscillator was fed successively into an audio-timer (which turned the tone on for 250 milliseconds at a rate of one per second), a 1 db. step attenuator (which the experimenter used to control intensity), and, through a double-pole double-throw (DPDT) switch, into a pair of PDR-8 headphones. An AC voltmeter (VTVM) and a Dumont oscilloscope were used for calibration.

Headphones and Pads.—The PDR-8 phones, previously calibrated by the Permaflux Company, have a reasonably flat response for the frequency range between 100 and 8000 cps; they were mounted in a standard aviation headband. Semi-plastic earphone pads (Type 001) supplied by the Grason Stadler Company were used, the in-

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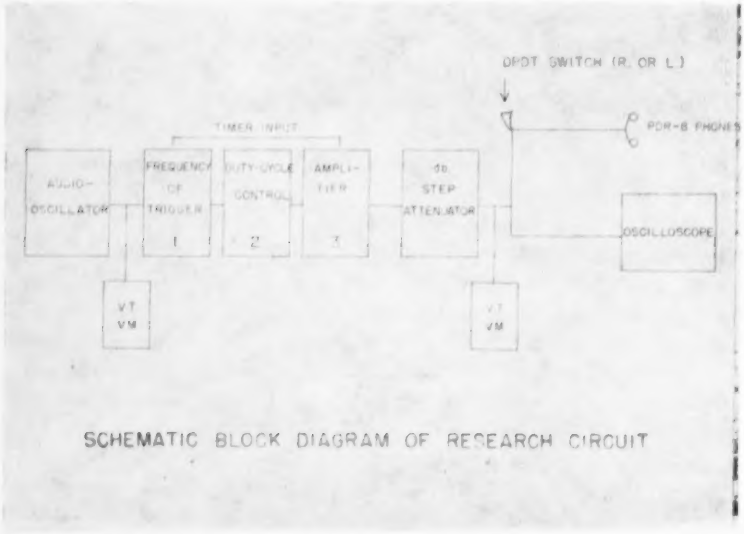

SCHEMATIC BLOCK DIAGRAM OF RESEARCH CIRCUIT

creased volume of the earphone cavity in these cushions serving to reduce physiological noise.[4]

Audiotimer.—This apparatus, specially built by R. G. Roush, of The Johns Hopkins University Electronics Laboratory,[6] consists of a phantastron circuit providing a self-repeated tone of variable duration. The 250 millisecond signal used for the threshold determination was set by means of a special Scalar unit (constructed by Roush) permitting accuracies of 0.001 millisecond. The selected repetition rate of one per second was measured by Chronoscope, and also checked by stop watch.

Subjects

Fifteen normal hearing subjects were recruited from personnel at The Johns Hopkins medical institutions. Persons with a sensitivity loss greater than 10 db. at more than one frequency were excluded.

Procedure

Aside from physiological and psychological factors, purely physical factors may contribute substantially to variability. Steinberg and Munson[7] have reported, for instance, that variations in earphone fit may account for standard deviations on the order of 5 to 7 db.; other investigators[8,9] have demonstrated that variations in the size and acoustic properties of the external auditory meatus may also play a part. For the present experiment, rigid procedures designed to control such variables were considered secondary to the listeners' comfort. After earphones were adjusted by the experimenter, subjects were permitted to make such further adjustments as they considered necessary; once earphone fit was reported satisfactory, no repositioning was permitted.

Criteria for the threshold response were derived from preliminary studies on optimal presentation time for a pulsed signal, and were strictly observed. For purposes of the present study, threshold was defined as the maximal attenuation at which three consistent responses could be elicited when the maximal presentation period for any single stimulus sequence was five seconds.

Immediately before each threshold measurement, a "clue" signal, approximately 10 db. above the calibrated zero point of the test frequency, was introduced.* The threshold determination was then made with an ascending technique.

Measurements were made over a period of several listening sessions in order to obtain information on both long-term and short-term variability.

*The experimental circuit had previously been calibrated on 109 normal ears, and the obtained threshold response curve was in good agreement with other findings reported in the literature.[2,8]

Variability in Repeated Normal Threshold Measurements

	Type of Observations	
	Short-Term	Long-Term
Number of observations	40	61
Mean difference in db.	0.8	2.8
Standard error of the difference	1.0	2.5

Results

The Table shows the results of repeated threshold measurements for a 250-millisecond pulsed tone repeated once per second. In general, differences between observers constitute a major factor, while differences between frequencies are not statistically significant; thus, only values for the grouped frequencies are shown. (Observations were made at the five octave intervals between 500 and 8000 cps.) Here, short-term observations refer to measurements made within one hour of each other; long-term observations refer to intervals of 1 to 46 days between successive measures.

No change in threshold was observed in 42.5% of the 40 short-term observations, and a shift of 1 db. was observed in 37.5%; of the 61 long-term observations, 26.2% of the thresholds remained unchanged and 14.8% shifted 1 db. For the normal hearers examined in this study, the most stable frequency was 4000 cps; for eight subjects, retested after a one-hour interval, the mean difference in measurement was 0.3 db.

These findings are viewed as an indication that, under controlled conditions, pulsed-tone thresholds measured in 1 db. steps have good repeatability.

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Clinical Bone-Conduction Audiometry

The Use of a Frontally Applied Bone-Conduction Receiver and the Importance of the Occlusion Effect in Clinical Bone-Conduction Audiometry

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General Considerations

Many otologists and audiologists, while having considerable confidence in methods of testing hearing by air conduction, have little confidence in bone-conduction tests carried out in the time-honored fashion with a bone-conduction receiver applied first to one and then to the other mastoid process. Many believe that bone-conduction testing has some value as a supplement to the classical tuning-fork tests, but that it lacks any useful degree of precision and must be allowed to serve only as an approximate guide to the nature, rather than an accurate measure, of a hearing impairment. One reason for this belief may be the observation that bone-conduction test results are evidently more readily influenced by a number of variable and extraneous factors than are air-conduction tests of hearing requiring the use of a pair of air-conduction receivers. The efficiency of bone-conduction hearing is, for example, influenced to a considerable degree by the position of the bone-conduction received—a difficulty countered by the widely practiced procedure of "searching" the mastoid process for its "most sensitive spot"; it has been suggested that these sensitive spots correspond to areas where the mastoid cortex is thin and the air cells extensive, allowing misleading resonance efforts to occur (E. Bárány,[1] 1938). If this be true, it would not be unreasonable to conclude that the validity of a bone-conduction measurement will depend at least upon the degree of pneumatization of the mastoid process. The sensitive spot of the mastoid may also be the area where contour ensures optimal contact between bone and bone-conduction receiver, and, if this be true, there will be mastoids where bone-to-receiver contact will always be efficient and mastoids whose shape prevents there ever being efficient contact.

It is common practice to test bone-conduction hearing with the bone-conduction receiver placed on the mastoid process of the tested ear and with an air-conduction receiver applied, for masking purposes, to the opposite and untested ear; the tested ear thus remains uncovered throughout the examination, and its sensitivity may be affected by ambient noise in the test room. Few otologists or audiologists are so happily situated that they can test hearing under conditions of quiet such that bone-conduction results will not be influenced by room noise.

There is, unfortunately, no method of calibrating bone-conduction receivers comparable to the objective comparative method of calibrating air-conduction receivers. Bone-conduction audiometers should each be calibrated by testing the bone-conduction hearing of young adults who have neither history nor evidence of aural disease. If these calibration tests are made under conditions of quiet, and if subsequent clinical tests are made in a relatively noisy office, clinical subjects with normal or near-normal hearing will give apparently poor results because their hearing will be affected to a greater or lesser extent by ambient noise. Conversely, if the bone-conduction receiver is calibrated on normally hearing subjects under noisy

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conditions, clinical bone-conduction measurements taken under noisy conditions upon subjects with considerable degrees of air-conduction loss will be misleadingly good because the hearing will not be affected by the noisy surroundings. In other words, so long as clinical bone-conduction hearing tests are conducted under noisy conditions and with the tested ear uncovered we cannot expect comparable test results on both the slightly and the considerably deaf. We can calibrate the audiometer so that it will give us reliable results in one group or in the other, but not in both. If both ears could be covered by headphones during bone-conduction tests, the effects of ambient noise upon tones above about 500 cps would be very much reduced ,and the chances of obtaining bone-conduction test results independent of ambient noise on both the slightly and the considerably deaf would be increased.

Another disadvantage of the classical method for testing bone-conduction hearing is that it is necessary to move the receiver from one side to the other when the bone-conduction examination of one ear is completed. There are cases where the first bone-conduction examination should be repeated in the light of the bone-conduction test results obtained on the second ear; in such cases the receivers will require reversal again. This involves very little time and trouble, but, in a busy clinic or office, time can become very valuable.

E. Bárány,[1] in 1938, drew attention to the fact that bone-conduction tests carried out in the orthodox fashion, with the receiver applied to the mastoid process, are of limited value. Such tests mainly measure "inertia" bone conduction, the efficiency of this type of bone-conduction hearing being partially dependent upon the efficiency of the middle-ear conduction mechanisms. For this reason, if for no other, the test cannot be regarded as giving a true measure of cochlear function alone. Bárány also mentions that the cartilage of the external ear provides an efficient pathway for sound to the middle and inner ears; thus if the bone-conduction receiver is placed on or near the pinna sound conduction will be more efficient than if the receiver is placed on the bone well away from the pinna. Positioning of the bone-conduction receiver on the mastoid is moreover critical, slight movements of the receiver causing relatively large changes in the stimulus at the cochlea.

E. Bárány deduces from experiment and theoretical consideration that the mode of suspension of the intratympanic ossicles is such that the inertia component of bone conduction will be at a minimum if the bone-conduction receiver is situated at the midline of the head, between the vertex and the occiput. Bone-conduction measurements made from this site will be less dependent upon the state of the middle ear than will those made from the mastoid process, but the efficiency of transfer of energy from receiver to skull will be influenced by intervening hair unless a special variety of bone-conduction receiver is used. Bárány's work suggests a second-best site, namely, the frontal bone, where the hair problem does not arise. Inertia bone conduction of the frontal bone will be less than if the mastoid process is used; there is less variation in bony contour, skin, and subcutaneous-tissue thickness above the glabella than there is at the mastoid process; and it is also far easier to specify the exact position of a bone-conduction receiver applied to the frontal bone than it is to specify the position of one applied to the mastoid. Moreover, the application of a bone-conduction receiver to the sagittal plane of the head between vertex and occiput presents considerable technical difficulties, which Bárány overcame by the construction of a complex suspension unit. An orthodox type of bone-conduction receiver is easily applied to the frontal bone.

The frontal-bone excitation site is less efficient than the mastoid process; that is to say, a bone-conduction receiver oscillating at a given intensity will appear louder when applied with given pressure to the mastoid process than when applied with the same

pressure to the frontal bone. But this disadvantage will be more than outweighed if measurements at the frontal bone give a more nearly true estimate of cochlear function than the measures obtained at the mastoid process.

A number of authors have commented upon the occlusion effect (R. Bárány,[2] 1910; Kobrak, Lindsay, and Perlman,[11] 1935; Kelly and Reger,[10] 1937; E. Bárány,[1] 1938; von Békésy,[3] 1941; Hirsh,[9] 1952; Littler, Knight, and Strange,[12] 1952; Everberg,[5] 1953; Rytzner,[14] 1954; Onchi,[13] 1954). Covering or in any other way occluding the external auditory meatus of a normal ear leads, under certain circumstances, to a true improvement of bone-conduction hearing—an improvement largely confined to sounds of low frequency and referred to as the "occlusion effect." It is therefore reasonable to suppose that, if only one ear is occluded during a clinical bone-conduction test, the interaural attenuation may appear to be less than if both ears were unoccluded or uncovered, and it may even be reduced below zero.

Consideration of these points leads to the conclusion that there may be advantages to be gained by applying the bone-conduction receiver to the frontal bone. Inertia bone conduction and cartilage conduction may be reduced. The exact position of the receiver can readily be specified and repeated from test to test and from patient to patient. The receiver can be held in a headband entirely separate from that carrying the air-conduction receivers, and the latter can remain in position throughout the bone-conduction test. Masking may be introduced as required, and there will be no necessity for changing the sides of either bone-conduction or air-conduction receivers. There is already general awareness of the fact that a single bone-conduction receiver applied to one mastoid process stimulates the two ears almost equally and that, for this reason, masking is necessary in all bone-conduction tests; the frontally applied bone-conduction receiver will similarly stimulate both ears.

Several problems confront us if we contemplate using occluded ears and a frontally placed bone-conduction receiver in clinical tests. The question of the effect upon bone-conduction efficiency of the normal variation in size of the frontal sinuses is of interest and may be of some importance; of more readily recognizable importance is the question of the significance of the occlusion effect.

Onchi[13] (1954) has suggested that the improvement in bone-conduction sensitivity resulting from occlusion will be affected by the attenuation of a pathological middle ear and that, if this attenuation is greater than the occlusion effect obtained with normal listeners, no improvement in bone conduction can occur in the pathological case. Onchi gives no indication of the number of cases in which he was able to make this observation; and he used earplugs to occlude the ears, thus complicating rather than simplifying the clinical bone-conduction test.

I have examined the effect of using a frontal bone-conduction receiver and occluded ears in a variety of clinical conditions, bearing in mind the possibility of improving clinical bone-conduction test methods without unduly complicating them. The bone-conduction hearing of a group of deaf and normally hearing listeners was measured using a frontally placed bone-conduction receiver in both the occluded and the unoccluded state. Occlusion was effected by covering the ears with the air-conduction receivers used for the routine air-conduction tests. In some of the cases similar measurements were made at the mastoid process in order to compare the efficiency of the two excitation routes. The magnitudes of the occlusion effects observed were related to the clinical conditions of the test subjects and, in some cases, compared with the occlusion effects observed when the bone-conduction receiver was applied to the mastoid process. The relation between air-conduction and bone-conduction thresholds was also examined and related to the clinical conditions of the test subjects. A group of

normally hearing subjects was similarly examined under conditions more nearly approaching absolute quiet in order to clarify the relationship between the occlusion effect and ambient noise.

Testing Equipment

The majority of the tests were made in a sound-treated testing room (average steady noise level measured at various times during several consecutive days being 35.8 db., A scale, G. E. Sound Level Meter). The exceptions to this rule were the normally hearing subjects tested in a quieter room, to which reference is made later.

The equipment used consisted of a commercial 5-db. step pure-tone audiometer of the RC oscillator type, using matched PDR 10 receivers in an HB7 headset. Masking was available in the form of white noise, its intensity being controlled by means of a 2-db. step attenuator. The bone-conduction receiver provided by the audiometer manufacturer was replaced by a lighter-weight hearing-aid type of bone-conduction receiver held in a light-weight spring-steel headband; voltage measurements across the substitute receiver demonstrated that no serious impedance mismatch had been thus introduced and that each 5-db. step of the attenuator changed the attenuation by between 3.5 and 6.5 db. The departures from the nominal 5-db. steps were not cumulative. A sponge-rubber cushion attached to the end of the headband not carrying the bone-conduction receiver served to separate this end of the band from the head, leaving only the bone-conduction receiver and the rubber cushion in actual contact. Implicit faith was placed in the manufacturer's air-conduction calibration of the audiometer, but the electrical output was checked from time to time at a predetermined attenuator setting for each frequency. No variations of more than 1.5 db. were observed, and the variations were not cumulative. The replacement bone-conduction receiver was calibrated by testing the hearing of 20 young adults who had never been exposed to noise of likely damaging intensity, who had normal tympanic membranes, no history of ear infections, and no reason to suppose that their hearing was subnormal. This report makes scant reference to the "normal" bone-conduction threshold obtained in this way, but, since the results with which it deals were almost entirely a product of a routine hearing testing service, the recalibration was a necessary preliminary to the expression of bone-conduction test results in more or less meaningful terms. The 5-db. step attenuator controlling the air-conduction output, calibrated in decibel hearing loss, was also used to control the bone-conduction output; throughout this report bone-conduction thresholds are given in the form of dial readings taken from this attenuator and are, therefore, meaningless except when related to the dial reading representing the average young normally hearing adult's dial reading at threshold for a test tone of given frequency.

White-noise masking was used extensively in these tests. When a sound stimulus is fed by air conduction into one ear of a normally hearing subject, the hearing of the opposite ear is depressed to a small extent despite the fact that every precaution may be taken to prevent cross conduction of the stimulus. The phenomenon has received considerable attention so far as the masking of one pure tone by another is concerned, and there is every reason to assume that this depression of hearing represents a form of central masking, that it is small, and that it is dependent upon intensity; but little information is available concerning the central masking effect of white noise upon hearing for pure tones. I have frequently observed that in deaf subjects white noise has a similar masking effect; if the effect is sufficiently large it should be taken into account in any examination involving the use of masking in an untested ear. It is also reasonable to suppose that, when a frontally applied bone-conduction receiver is used, both ears are being stimulated equally in the normal listener and that the threshold-raising effect of a unilateral mask will, in part, be due to the difference between binaural and monaural listening.[16] In an effort to gain information concerning the magnitude of this effect in clinical testing, those normal subjects whose test results were used for calibration purposes were tested both in the quiet and in the presence of a unilateral white-noise stimulus at a sensation level of 50 db. Figures presenting the average threshold-raising effect produced under these conditions at any given frequency were used as correction factors in surveying the results of the bone-conduction tests on listeners with abnormal hearing. The limitations of this part of the investigation are discussed later.

Procedure and Rationale

Each subject in the series was first given a pure-tone air-conduction threshold test. The headphones were put on and any hair present pushed away from the receiver. Each receiver was separated from the head by a double-thickness layer of Chix, a third square of Chix separating the headband from the hair. The Chix squares are used in the interest of cleanliness, this being considered a better practice than washing the receiver cushion after use. The material of which the squares are made is part cotton and part rayon, in the ratio of 1:3, bonded by a polyvinyl chloride resin polymer. It is practically rustle-free. Experiment showed

that the only likely source of rustling noise was contact between the receiver cords and the Chix squares; precautions were therefore taken to isolate them. No doubt the use of these squares results in a small attenuation of the test tones, but in a group of 20 patients no measurable attenuation effect could be found (5-db. step attenuator was used).

The use of these squares will probably diminish the occlusion effect, but my interest lay in clinical bone-conduction test methods and not in the occlusion effect per se.

The procedure used in determining the pure-tone threshold was usually the following:

1. Instruct the patient.

2. Present a 1000-cps tone to the subject's better ear for about 2.0 seconds well above the probable threshold, or to either ear when no information is available concerning the comparison of the two, repeating the presentation at a higher intensity if there appears to be some doubt about recognition of the tone.

3. Repeat the tone presentations, lowering the intensity by 10 db. each time until the subject no longer indicates hearing the tone.

4. Repeat the tone presentations, raising the intensity by 10 db. each time until the tone is heard again.

5. Repetition of Steps 3 and 4 using 5-db. steps.

6. Record the "hearing-loss" reading at which the subject indicates that he heard the tone twice out of two or three presentations and 5 db. below which he fails to hear the tone twice out of two or three presentations.

7. Change the frequency of the test tone to 2000 cps and repeat Steps 2 through 6.

8. Repeat Step 7 for the frequencies 4000, 8000, 500, and 250 cps, in that order.

9. Repeat Steps 1 through 8 on the opposite ear.

It is recognized that this test method is not that commonly advised for hearing testing; but it gives every appearance of being satisfactory in the majority of cases, and it has the merits of brevity and avoids awkward figures. There is a small percentage of subjects where there is obviously great uncertainty about recognition of near-threshold sounds; in these persons the intensity range of uncertainty was traversed four times in 5-db. steps, twice ascending and twice descending, the tone being presented at each dial reading covered; one reading was noted for each traverse—while decreasing the intensity, that hearing-loss reading at which the tone was last heard and, while increasing the intensity, the reading at which the patient first responded. The resulting four dial readings were then averaged, the recorded reading being this average if it was a multiple of five, or the nearest multiple of five below the average when it was not such a multiple.

The identity of the listening ear was checked in every case which showed an apparent loss of 50 db. or more by raising the intensity of the test tone 5 db. above the threshold value and asking the listener where the sound appeared to be. (It was assumed at this point that bone conduction was normal and that the interaural attenuation was 50 db.) Then if, for example, the sound was being delivered to the left ear and appeared to the listener to be in the left ear or to the left of the midline, the threshold value was regarded as being that of the left ear. If, however, the sound appeared to be elsewhere than to the left, white noise was introduced into the right ear (from a commencing level of 60 db. above normal threshold) and the intensity of the noise (and of the tone, if necessary) increased until the apparent position of the test tone moved to the left side of the head; the pure-tone threshold was then redetermined without further change in the intensity of the white-noise mask. When the test tone could be referred to the tested side, a result was recorded and the testing continued; when referral could not be produced, I assumed that, for the purpose of this study, there was no result to be recorded for the ear to which the sound could not be referred.

The next step was to apply the bone-conduction receiver to the midline of the forehead in such a way that the lower margin of the receiver's input plug was ½ in. above an imaginary line between the upper margins of the orbits and that its long axis ran perpendicularly. The steel headband of the bone-conduction receiver was kept clear of the headband of the air-conduction receivers. No additional Chix squares were used.

A straightforward unmasked "occluded" bone-conduction threshold was then determined, the procedure used being similar to that described for the air-conduction thresholds except that the 8000-cps tone was omitted and no distinction was made at this stage between the two ears. The air-conduction receivers were disconnected from the audiometer during all bone-conduction tests. The results of these measurements were recorded, and then, with few exceptions, the subjects were asked to localize the sounds. When a sound was localized to the center of the head, the bone-conduction reading was assumed to be that of both ears. If it was referred to one side of the midline, the reading was assumed to be the bone-conduction threshold of the ear of that side and an attempt was then made to mask that ear in order to obtain the bone-conduction threshold of the other ear. The technique of masking was that described for air-conduction testing, and results were recorded only when it was possible to refer the test tone to the side under examination.

The approximate amount of masking that can be used initially in air-conduction and bone-con-

duction testing may be calculated, using the following abbreviations:

Let

Mask intensity	$=MI$
Mask effect of MI	$=ME$
Maximum permissible MI, such that the tested ear remains uninfluenced by the masking stimulus (ignoring central masking)	$=MI_{max}$
ME of MI_{max}	$=ME_{max}$
Air-conduction loss of masked ear	$=AC_m$
Bone-conduction loss of masked ear	$=BC_m$
Bone-conduction loss of unmasked ear (this must be assumed to equal BC_m in the absence of information to the contrary)	$=BC_{um}$
Interaural attenuation	$=$attenuation
Approximate sensation level of white noise required to produce a just-detectable masking effect	$=$white-noise factor

Now

$$MI_{max} = \text{attenuation} + \text{white-noise factor} + BC_{um} \quad (1)$$

and

$$ME_{max} = MI_{max} - (\text{white-noise factor} + AC_m)$$
$$= MI_{max} - \text{white-noise factor} - AC_m \quad (2)$$

Now substituting the value of MI_{max} in Equation 1 for MI_{max} in Equation 2

$$ME_{max} = \text{attenuation} + \text{white-noise factor} + BC_{um} - \text{white-noise factor} - AC_m$$
$$= \text{attenuation} + BC_{um} - AC_m$$

It may be assumed that the "white-noise factor" equals 30 db., that BC_{um} equals BC_m, and that "attenuation" equals 50 db. Equations 1 and 3 may therefore be rewritten

1. $MI_{max} = 50 + 30 + BC_m$
3. $ME_{max} = 50 + BC_m - AC_m$

It must be emphasized that these simple calculations only give an approximate guide to the amount of masking that should be used initially in a masked hearing test; as the masked test proceeds it may well be found that BC_{um} is certainly poorer than BC_m, in which case MI may be increased above the value of MI_{max} calculated initially. The more reliable or least unreliable method of deciding whether adequate masking has been used is the question "Which ear is hearing the test tone?".

If we assume a hypothetical case of bilateral middle-ear deafness with 55 db. of conductive loss and an unmasked bone conduction of 5 db., then clearly $MI_{max}=85$ db. and $ME_{max}=0$ db. In point of fact cases of this type occur not infrequently, and in these cases any masking introduced into one ear will mask both ears equally.

There is very little authoritative advice available for the audiologist who must know when masking is necessary in air-conduction tests. Many of even the better authorities will either beg the question by using such vague expressions as "when indicated" and "adequate masking" or specify the particular example where there is 50 db. or greater difference between the air-conduction losses of the two ears. This is only one example where masking is necessary, the crux of the matter being that masking is required in air-conduction tests when there is a difference of 50 db. or more between the better bone conduction and the other ear's air-conduction thresholds. Subjects with bilateral otosclerosis often require masked air-conduction tests, but they almost never have a difference of 50 db. between the air-conduction thresholds of the two ears.

A number of approximations have been made in this discussion of masking technique. The "white-noise factor" has been assumed to equal 30 db.; the interaural attenuation has been assumed to equal 50 db. but will depend to some extent upon the type of air-conduction receivers used. It is therefore a good deal safer in routine clinical testing to be on the alert for these cases where cross conduction of the test tones may be occurring and to check by asking the subject which ear hears the tones.

I may well be mistaken in relying to such an extent upon the patient's lateralization of a test tone, but clinical experience suggests very strongly that the principle is almost always trustworthy. There are cases where odd referral judgments are given, but in my experience they have been rare.

Limitations to the value of this masking technique for air- and bone-conduction testing are still to be expected on theoretical grounds, and my clinical experience has reaffirmed their reality. There were subjects where the cross conducted test tone was of such an intensity that it could not be masked by a tolerable level of such an inefficient masking stimulus as white noise. There were cases, notably otosclerotics, where it was apparent that both ears were being masked to equal extents by a masking stimulus delivered by air conduction to only one ear, the air- or bone-conducted sound appearing to be fixed at one point in the head despite any changes in the intensity of the masking stimulus.

Once the investigations with occluded ears were completed, the bone-conduction examinations were repeated for each ear while the one under investigation was "unoccluded"; that is to say, the bone-conduction tests were repeated while the headphone that had been covering the tested ear was slid forward onto the area of the head anterior to the pinna. The ear remaining occluded was masked if and as it had been necessary during the occluded bone-conduction tests, while the unoccluded ear's bone conduction was measured. The situation was then reversed, the masked occluded ear becoming the unmasked unoccluded, and vice versa. Examination with an otoscope always showed that the nearness of the inactive air-conduction receiver was without effect on the

caliber of the unoccluded ear's external meatus. The change in position of the headphones was made in such a fashion that the bone-conduction receiver and its headband were not disturbed; that the air-conduction receiver headband was not allowed to touch the bone-conduction headband, and that the goodness of fit of the operative air-conduction receiver was not diminished. The bone-conduction tests with unoccluded ears were carried out in the same fashion as described for the occluded bone-conduction tests.

The series of tests described usually resulted in a complete air-conduction and bone-conduction audiometric analysis. In some subjects and at some frequencies masked audiometry proved impossible and only one ear could be tested. The complete test sequence was time-consuming, and in some subjects shortage of time precluded more than the air-conduction and occluded bone-conduction tests.

In some of the normal persons who were tested purely for the purposes of this investigation, the bone-conduction thresholds obtained—one occluded set and one unoccluded set—were not masked. Economy of time was the only consideration in this departure from the usual technique.

Subject Classification

A simple three-class system was adopted in classifying the conditions of the ears examined. Class 1 contains all the ears showing visible abnormalities of the middle ear, such as active suppuration, perforations or scars of the tympanic membrane, fluid in the tympanic cavity, myringitis, or otitis externa involving the drum. Class 2 contains those ears where a diagnosis of otosclerosis had been reached. Class 3 contains all the ears not included in Classes 1 and 2. This simple classification was used because it was felt that a more detailed system would require greater attention to tuning-fork and other hearing test results, thus confusing the issue. Some of the otosclerotics who were tested during their first visit to the hospital were diagnosed before the results of the audiometric examination were known; some of them had been tested and diagnosed elsewhere at an earlier date and volunteered their previous diagnoses to the examining clinician. At all events it must be assumed that with many of the otosclerotics audiometry and/or tuning-fork tests had played some part in the diagnoses used in my classification. I believe that, apart from these otosclerotics, the classification adopted was applied without any consideration of test results.

I always endeavored to ignore the clinical findings before a case was tested. As a matter of general interest the cases were reexamined clinically after testing, but in only a few subjects was my opinion at variance with that of the clinicians who had made the examination. These few cases were classified on the basis of the opinion of the first examining clinician and not on the basis of my opinion. Cases of mine tested during the time represented by this study are excluded from the series.

Results

Clinical Material.—Two hundred eighty-five subjects were examined, of whose ears 175 were in Class 1, 73 were in Class 2, and 255 were in Class 3.

The visible abnormalities of the drumheads of the Class-1 ears and the final diagnoses of the Class-3 ears, whose drums were normal in appearance, are listed in Table 1.

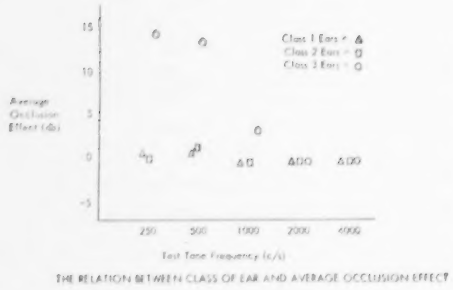
TABLE 1.—*Clinical Diagnoses of Ears Examined*

Class	Clinical Observations	No. of Ears Examined
1	Healed perforations	82
	Active suppurative otitis media	39
	Fenestrated ears	17
	Dry perforations	16
	Otitis externa (with affection of drum)	10
	Fluid in middle ear	5
	Otitis externa (with myringitis)	4
	Acute barotrauma	2
2	Otosclerosis	73
3	Presbycusis	60
	Nerve deafness of unknown etiology	43
	Ménière's disease	42
	Normal hearing	40
	Acoustic trauma	22
	Congenital or familial deafness	18
	Presbycusis and acoustic trauma	14
	Exotoxic deafness	6
	Intracranial neoplasm associated with deafness	3
	Postmeasles nerve deafness	2
	Leukemia associated with deafness	2
	"Blocked ears" (see text)	2
	Blood on membrana tympani (see text)	1

Table 2 shows the percentage distribution of the tested ears over the air-conduction hearing-loss range for each of the five bone-conduction frequencies used.

TABLE 2.—*Percentage Distribution of Ears Examined*

Test-Tone Frequency (Cps)	Class	Air-Conduction Loss (Db.)									
		0	10	20	30	40	50	60	70	80	90
250	1	14	30	12	12	18	7	5	2		
	2				1	16	40	33	10		
	3	48	27	14	7	3	1				
500	1	10	19	21	19	12	12	6	1		
	2				10	21	33	20	6		
	3	35	27	17	7	7	4	2	1		
1000	1	9	12	22	17	17	10	7	4	2	
	2				11	22	44	23			
	3	34	22	13	11	8	9	3			
2000	1	11	12	19	17	22	6	11	1	1	
	2			5	20	32	25	18			
	3	30	15	10	13	17	6	9			
4000	1	2	5	8	16	20	12	12	13	6	6
	2		2	4	16	27	23	16	10	2	
	3	15	11	14	11	12	10	10	11	4	2

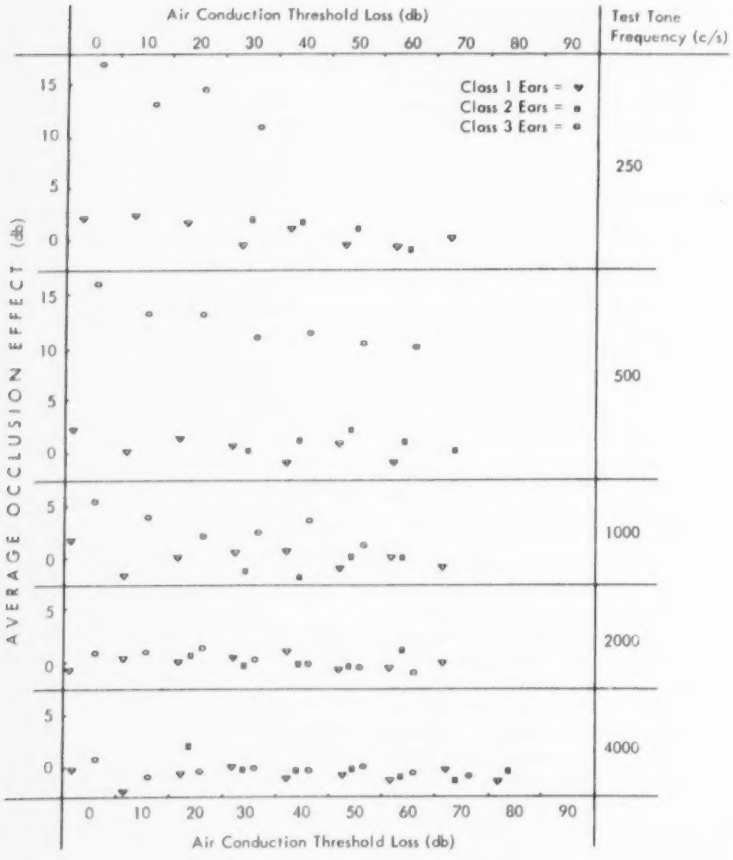


THE RELATION BETWEEN CLASS OF EAR AND AVERAGE OCCLUSION EFFECT

Figure 1

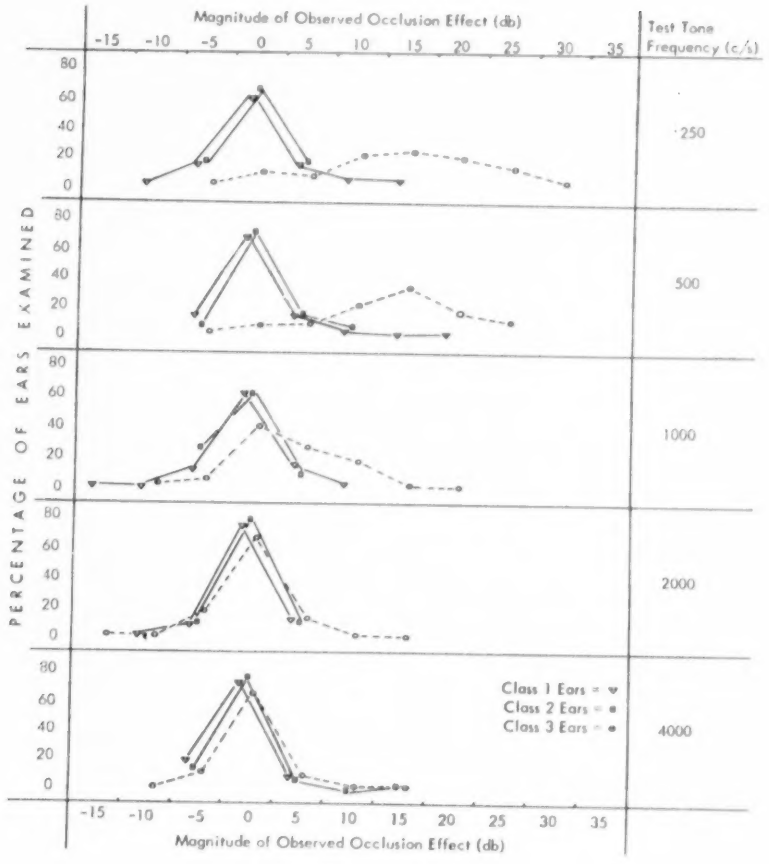
The Influence of Clinical Condition upon the Occlusion Effect.—Figure 1 shows the average occlusion effects observed in each of the three classes of ears (irrespective of hearing loss) and at each of the five test frequencies used. In Figure 2 the information carried in Figure 1 is additionally related to the magnitude of the air-conduction hearing loss. Figure 3 relates the magnitudes of the observed occlusion effects to the percentage of ears examined showing these occlusion effects.

The Normal Occlusion Effect in the Quiet.—Figure 4 shows the relation between



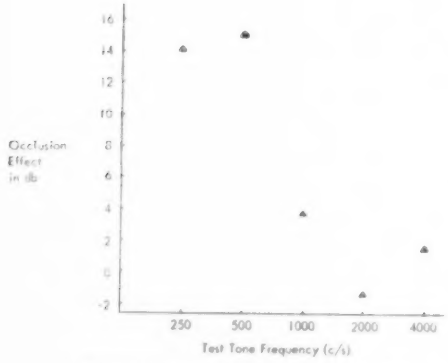
THE RELATION BETWEEN AIR CONDUCTION LOSS AND OCCLUSION EFFECT

Figure 2


Magnitude of Observed Occlusion Effect (db)
-15 -10 -5 0 5 10 15 20 25 30 35
Test Tone Frequency (c/s)
PERCENTAGE OF EARS EXAMINED
80 60 40 20 0
250
500
1000
2000
4000
Class 1 Ears = ▼
Class 2 Ears = ●
Class 3 Ears = ●
Magnitude of Observed Occlusion Effect (db)

PERCENTAGE DISTRIBUTION OF OCCLUSION EFFECTS

Figure 3



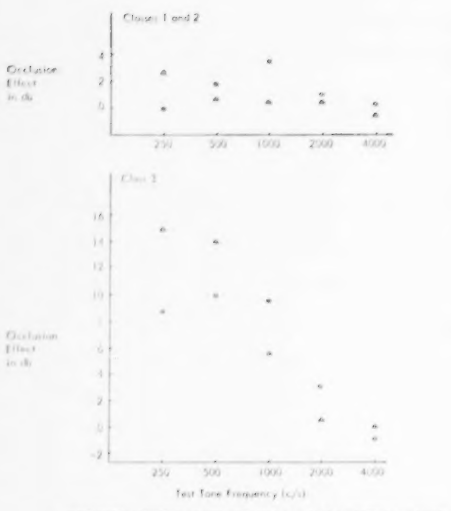
NORMAL LISTENERS' OCCLUSION EFFECTS IN THE QUIET

Figure 4

the average occlusion effects observed (frontal site) and the frequency of the test tone for the group of normal listeners tested in the more efficient sound-treated room. During these tests the sound-level meter (G. E. Scale A) read between 26 and 28 db.*

Occlusion Effects, Using Frontal and Mastoid Routes.—The 44 cases whose bone-conduction hearing was examined at both frontal and mastoid sites were also used to determine whether the occlusion effects

* The Section of Biopsychology of the University of Chicago granted the author permission to use its sound-proof room.



OCCLUSION EFFECTS AT THE FRONTAL (●) AND MASTOID (▲) SITES

Figure 5

to be observed at the two sites differed in any way. Their mastoid bone conduction was examined in both unoccluded and occluded conditions, occlusion being effected by means of a perforated earplug connected to a 6-in. rubber tube loosely filled with cotton. The perforated plug was used to avoid any air-pressure changes in the external ear, and the cotton was added to diminish resonance effects. It is likely that the use of cotton diminishes the occlusion effect. Figure 5 shows the results obtained, the observed occlusion effects in Classes 1 and 2 and in Class 3 being related to test-tone frequency and the site of application of the bone-conduction receiver.

The Relation Between Air-Conduction and Bone-Conduction Losses.—The relation between bone-conduction dial reading at threshold (frontal site), air-conduction threshold loss, ear class, and test-tone frequency is shown for both the occluded and the unoccluded condition in Figure 6.

Relative Efficiency of Frontal and Mastoid Routes.—Forty-four consecutive cases (39 ears in Classes 1 and 2 and 37 ears in Class 3) were examined, first, with the use of a frontal bone-conduction receiver and, secondly, with the receiver applied to the mastoid process. The "sensitive spot" of the mastoid was not sought, the receiver being place approximately ⅜ in. from and parallel to the mastoid-pinna junction. The frontal site was shown to be less efficient than the mastoid (threshold dial readings being greater with the former), the magnitude of this deficiency being shown in Figure 7 for each of the five frequencies concerned.

The Central Masking Effect of White Noise.—The bone-conduction thresholds of 37 normally hearing listeners were determined in three ways.

1. Frontal bone-conduction receiver with occluded ears.

2. As 1, but with 50 db. of white noise in the left ear.

3. As 1, but with 50 db. of white noise in the right ear.

The differences 2 minus 1 and 3 minus 1 were recorded and averaged, thus:

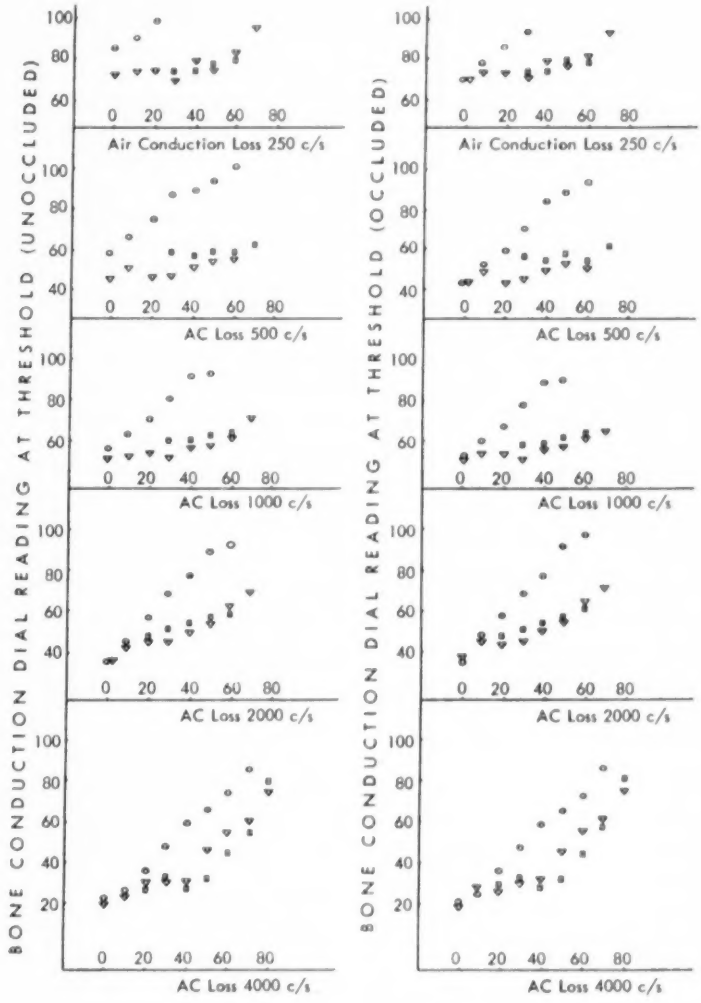
	250 Cps	500 Cps	1000 Cps	2000 Cps	4000 Cps
Mean (Db.)	1.48	2.16	4.59	4.32	2.43
SE$_{mean}$ (Db.)	0.77	0.74	0.73	0.73	0.72

The figures given in this tabulation were regarded as giving a measure (albeit crude) of the contralateral threshold-raising effect of white noise and, taken to the nearest 5 db., were used as correction figures in the clinical test results, thus:

	250	500	1000	2000	4000
Correction Figure (Db.)	0	0	5	5	0

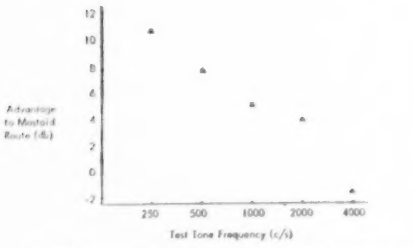
For example, if when using 70 db. of white noise in the untested ear the masked bone-conduction threshold (dial reading) was 80 db. at 2000 or 1000 cps, the result recorded was not 80 but 80 minus the correction factor, viz., 75 db. If the threshold dial reading at 250, 500, or 4000 cps was 80 db., this result was recorded unchanged, since the correction factor is zero for each of these three frequencies.

Variation in Pressure of the Frontally Applied Bone-Conduction Receiver.—At the conclusion of the examinations of each of 50 consecutive subjects the pressure exerted by the bone-conduction receiver was estimated by attaching a metric spring balance to it and pulling the balance and receiver about ⅛ in. away from the head. The pull


BONE CONDUCTION DIAL READING AT THRESHOLD (UNOCCLUDED)
BONE CONDUCTION DIAL READING AT THRESHOLD (OCCLUDED)
Air Conduction Loss 250 c/s
AC Loss 500 c/s
AC Loss 1000 c/s
AC Loss 2000 c/s
AC Loss 4000 c/s

AIR CONDUCTION/BONE CONDUCTION THRESHOLD RELATIONS FOR CLASS 1 (▾), CLASS 2 (•), AND CLASS 3 (∘) EARS

Figure 6



RELATIVE EFFICIENCY OF MASTOID AND FRONTAL BONE CONDUCTION

Figure 7

necessary was read off the scale of the balance and recorded to the nearest 10 g. The average pull required was 448.4 g (S. D. = 32.6 g).

Comment

Clinical Material.—The unequal distribution of cases among the three classes is to be regretted but is one of the hazards of this

type of survey where case selection is to be almost completely avoided.

Another unavoidable difficulty is the tendency of the otosclerotics to have air-conduction losses in the region of 30 to 60 db. The other two groups show a more even distribution over the hearing-loss range, but the Class-3 cases still show some tendency to group near the zero hearing-loss region, a tendency attributable in part to the inclusion in this class of the normally hearing subjects examined for calibration purposes and to the limited range of the bone-conduction testing equipment at 250 and 500 cps.

The number of ears in each category examined at any one frequency never equalled twice the number of subjects in that category. This was the result of the practical considerations or limitations to which reference has already been made; thus in some of the normals only a single set of bone-conduction results was sought; in some cases (mostly to be found among the otosclerotics) it proved impossible to mask out an ear whose bone-conduction hearing was not under test, and in others (mostly in Class 3) the necessary masking stimulus was not tolerated. For these subjects and at the frequencies concerned only one set of results was obtained.

The Influence of Clinical Condition upon the Occlusion Effect.—The outstanding observation to be made is that, while the group of ears (Class 3) having no visible abnormalities of the drumhead and not having otosclerosis showed considerable average occlusion effects at 250 and 500 cps and a smaller average occlusion effect at 1000 cps, the otosclerotics and the ears with visible abnormalities of the drum showed almost negligible average occlusion effects at these frequencies. Assuming that an occlusion effect is a bone-conduction hearing improvement of 5 db. or more, the distributions of occlusion effects in each of the three classes at 250 and 500 cps are likely to arise by chance only once in more than 1000 such trials (χ^2). Analysis of the results indicates moreover that the absence of the occlusion effect is not related to the magnitude of any deafness present, and that the magnitude of the occlusion effects that were observed in the Class-3 ears shows a tendency toward an inverse relation with the air-conduction threshold loss. There is a possibility that the effects of ambient noise are responsible for this inverse relationship, although the results found in the Class-1 ears with small threshold air-conduction losses and the fact that the bone conduction-air conduction relation for Class-3 ears is, at each frequency, a near-straight line with a slope of one minimize this possibility to the point of insignificance (Fig. 6). Nevertheless, repetition of the tests on the group of normal listeners under more quiet conditions supplied confirmatory evidence. The figures (Fig. 4) showing the average occlusion effects shown by normal subjects in the quieter room are very similar to those of the Class-3 ears tested in less quiet conditions (Fig. 1) and to those of the Class-3 ears with normal hearing (Fig. 2). The suggestion that the occlusion effects observed in these investigations are not related to the ambient noise present in the test rooms could be better supported if information were available concerning the spectrum of the noise still present in the quieter test room, but, unfortunately, this information is lacking.

The operational range of the bone-conduction equipment was limited at 500 cps and severely limited at 250 cps; these limitations resulted in the exclusion from the series of many ears in Class 3 showing large occlusion effects, thus progressively reducing the size of the average occlusion effect as the air-conduction threshold loss increased. It may therefore also be true that, in all cases, the magnitude of any occlusion effect shown is unrelated to the magnitude of any deafness present.

The value of all the observations made on the otosclerotics must be tempered by the narrow range of air-conduction losses represented.

It is appropriate at this point to mention the last two cases listed in Table 1.

The first of these was an inpatient on the general surgical service of the University of Chicago Clinics, convalescing from an abdominal operation. She claimed that since surgery she had had a blocked feeling in both ears. Examination revealed no visible abnormality of the ears, nose, or throat, and air-conduction audiometry showed no hearing loss; but bone-conduction audiometry showed that her bone-conduction hearing was better than the unoccluded average normal at 250 through 1000 cps, and she showed no occlusion effect at these frequencies.

The second of these two cases was an outpatient who had received a blow on the right ear three weeks previously; the blow caused bleeding from the ear and, the patient claimed, some deafness. Examination showed a normal left ear and a right ear that was normal except for a small spot of clotted blood near the umbo; the origin of the blood could not be determined. At the time of examination there appeared no justification for putting the right ear in any group other than 3. Later information would have justified its inclusion in Class 2, but the classification was not changed. This patient's right ear showed no deafness, better than normal low-tone unoccluded bone-conduction hearing, and an absence of an occlusion effect; air-conduction and unoccluded bone-conduction hearing in the left ear were normal, and the occlusion effect was present.

Mastoid and Frontal Occlusion Effects.—It is important that, in changing the site of the bone-conduction receiver in clinical bone-conduction tests, no additional complicating phenomena be added to the already complex bone-conduction mechanism. Comparison of the occlusion effects observed under the two conditions suggests that the frontal site has nothing peculiar to it in this respect. The magnitude of the average effect observed at the low frequencies is less for the mastoid site than for the frontal; but the methods of occlusion could not be identical, and reference has already been made to the fact that the cotton-filled tube will tend to reduce the occlusion effect in the mastoid tests.

The Air Conduction-Bone Conduction Relation.—Figure 6 demonstrates that at 250, 500 (and 1000) cps the Class-3 ears' unoccluded average normal bone-conduction threshold (corresponding to the normal obtained during standard calibration procedures) was not the same as the Class-1 ears' unoccluded normal threshold. But this difference disappeared when the tests were carried out in the occluded condition. The Class-1 cases thus behaved as if they were in a constant state of built-in occlusion.

In 1910 R. Bárány [2] published experiments demonstrating the increase of bone-conduction hearing resulting from a minute load of mercury or petrolatum (Vaseline) placed upon the normal tympanic membrane. In 1938 E. Bárány [1] interpreted these findings as indicating that the bone-conduction mechanism is normally in a state of unstable equilibrium at which conduction is reduced to a minimum; only slight disturbances are required to upset this state of equilibrium and to improve bone-conduction hearing. E. Bárány's suggestion applied to these Class-1 ears would serve to explain the pathological increase in bone conduction, and the observation that the Class-1 ears with small or zero air-conduction losses show no true occlusion effect indicates that the disturbance of ossicular equilibrium can occur without any change in air-conduction hearing. There is no justification for assuming that the mechanism of the true occlusion effect observed in Class-3 ears is in any way similar to the "built-in occlusion effect" present in Class-1 and Class-2 ears. Comments must be limited at present to the observation that the two effects are of similar magnitudes and have similar frequency distributions.

It is apparent that, in the group of Class-1 ears examined (the ears with abnormal membrana tympani), the average bone-conduction loss increases as the air-conduction loss increases from zero. There are several

possible explanations for this phenomenon, the most important being the following:

1. "Bone conduction" is to some extent directly dependent upon middle-ear efficiency, and when we measure clinical bone conduction at the mastoid or frontal bones we are measuring not "cochlear reserve" alone but a compound of cochlear reserve and of middle-ear function.

2. The pathological process causing a progressive middle-ear loss progressively worsens true cochlear function.

3. The subjects with severer middle-ear damage will tend to be the older subjects in such a group and will therefore have "nerve losses" resulting from age or other changes.

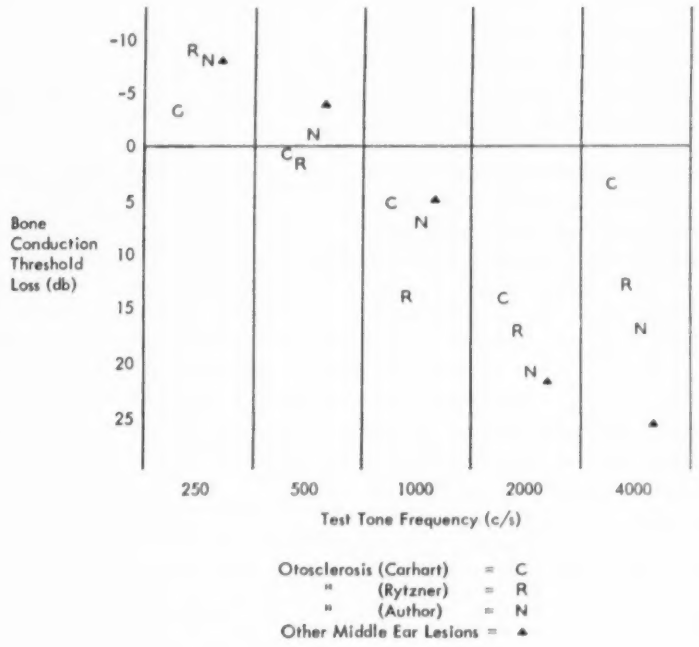
The third of these possibilities, the contribution of coincidental age changes, is likely to be in evidence at 2000 and 4000 cps but is unlikely to be a contributing factor at 500 and 250 cps. Nevertheless, the age-air conduction loss relation among the Class-1 ears at 500 cps does show a similarity to the bone conduction-air conduction relation (in other words, just as the Class-1 subjects with the greater air-conduction losses have the greater bone-conduction losses, so the older subjects in the same class have the greater bone-conduction losses).

None of these possibilities can be dismissed or definitely implicated at present, but it would appear that the first and/or the second may be operating at low frequencies and that all three may be operating at higher frequencies.

There is a fourth factor whose relation to the observed positive correlation between air- and bone-conduction losses in middle-ear disease may not be insignificant and whose presence may well repay further study: It is that with all orthodox air- and bone-conduction testing equipment we are, because of physical limitations, unable to measure pure middle-ear deafnesses of more than about 50 to 60 db.

At most of the five frequencies used for bone-conduction testing there is little justification in my findings for regarding the ears of the otosclerotics (Class 2) as differing markedly from the Class-1 ears in terms of the relation between air-conduction and bone-conduction losses. At 500 cps there is, however, a difference. At this frequency the average bone-conduction loss of the otosclerotics shows far less tendency to increase as the air-conduction loss increases.

Carhart[5] (1950) was the first to draw attention to what has now become known as the "Carhart notch"—the characteristic shape of the otosclerotic's bone-conduction audiogram. Carhart and McConnell[6] (1952) later observed that otosclerotics' bone-conduction thresholds are raised by an average of −3.2 db. at 250 cps, 0.6 db. at 500 cps, 5.3 at 1000 cps, 14.1 at 2000 cps, and by 3.4 db. at 4000 cps. Carhart's cases were probably a selected group, being those cases deemed suitable for surgical treatment, while I have included every case diagnosed as otosclerosis irrespective of degree and loss; and Carhart was not able to investigate the general relation between bone-conduction and air-conduction losses. When my average bone-conduction figures for those Class-2 cases with the air-conduction losses between 45 and 60 db. are compared with the unoccluded normal bone-conduction thresholds, a fair degree of agreement between my figures and those of Carhart is revealed. Rytzner[14] in 1954 repeated the type of investigation Carhart had made earlier, using test subjects selected in much the same fashion as Carhart's cases had been selected. Rytzner's figures for the average bone-conduction losses found in his group of otosclerotics are similar to those of Carhart and to my "selected group" averages. A similar selection procedure applied to my Class-1 ears (including thus only those subjects with 45 to 60 db. air-conduction losses) results in a set of figures which show that these cases have something in common with the otosclerotics. They have better than normal average bone-conduction hearing at 250 cps, and they have a bone-conduction dip at 2000 and 4000 cps; they differ from the otosclerotics in the size of the dips and in showing better than normal bone-conduction hearing at 500 cps. The figures discussed in this section concerning the Carhart notch are illustrated in Figure 8.



AVERAGE BONE CONDUCTION THRESHOLD LOSSES OF SUBJECTS WITH OTOSCLEROSIS AND WITH OTHER FORMS OF MIDDLE EAR ABNORMALITY

Figure 8

The Relative Efficiency of Mastoid and Frontal Sites.—The results confirm the contention that the efficiency of stimulation is reduced for most frequencies when the bone-conduction receiver is transferred from the mastoid to the frontal bone; there is a suggestion that at 4000 cps the reverse is true, there being a small efficiency difference in favor of the frontal site at this frequency. The significance of the average differences between frontal and mastoid site thresholds (these differences being assumed to provide a measure of the efficiency difference between the two sites) was computed on the basis of the *t*-test, the true difference being assumed to be zero. The results indicated that the efficiency differences observed at 250, 500, 1000, and 2000 cps could have arisen by chance in fewer than 1% of such trials, and that the difference observed at 4000 cps could have arisen by chance more than 10% of the time. It may therefore be claimed that the results shown in Figure 7 for the test-tone frequencies 250, 500, 1000, and 2000 cps are significant and that the result at 4000 cps indicates no more than a trend in the direction shown.

The similarity of the occlusion effects observed with the mastoid and the frontal bone-conduction receiver has been commented upon. The degree of significance of the efficiency differences observed (Fig. 7) between the sites provides additional evidence to support the claim that the only difference between the two types of clinical bone-conduction test (mastoid and frontal) is one of efficiency. This claim is further substantiated for each of the five test-tone frequencies by rank-order correlation tests, which indicate that the rank-order differences are not significant at the 1.0% level.

The Central Masking Effect of White Noise.—White noise is not an efficient masking stimulus (Denes and Naunton,[7] 1952), and it can be replaced by more adequate stimuli. The "central masking effect" of any mask used should be examined in greater detail, and corrections should be made whenever a mask is used in tests requiring a degree of accuracy over and above that acceptable in routine hearing tests. The magnitude of the masking effect of white noise probably resembles that of pure tones; if this be so, then the effect can be ignored in routine tests.

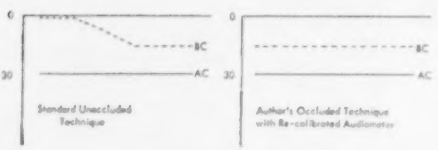
Pressure of Receiver.—It cannot be denied that the pressure exerted by the bone-conduction receiver will be one of several factors determining the efficiency of cochlear excitation in the circumstances described. The pressure variations observed in these tests were not great, but their significance remains uncertain at the present time.

General Considerations.—I set out to simplify rather than complicate clinical bone-conduction test methods but have succeeded only in reemphasizing the complexity of the mechanism under investigation.

Clearly all the features touched upon in this report must be reexamined by a variety of improved techniques, and this report is presented to stimulate the interest of other clinicians in the phenomena associated with normal and abnormal clinical bone-conduction hearing.

Clinical Implications.—The use of the frontally applied bone-conduction receiver in clinical audiometry has much to recommend it, and the sensitivity loss its use entails is not serious.

Measures of cochlear function obtained by bone-conduction tests, whether at the frontal or mastoid bones, are dependent to some extent upon middle-ear function, and the Carhart notch may be regarded as an illustration of this fact. All pathological conditions of the middle ear appear to modify our measures of clinical bone-conduction hearing in similar fashions, the extent of the modification being related to the magnitude of the concomitant air-conduction loss.



STYLIZED AUDIOGRAMS (STANDARD AND OCCLUDED TECHNIQUES) OF HYPOTHETICAL EAR WITH MIXED DEAFNESS

Figure 9

The occlusion effect appears to be an "all-or-none" effect, and pathological middle ears may, for convenience, be regarded as being in an occluded state.

The "built-in occlusion effect" will appear to minimize the "nerve" part of a mixed deafness when clinical bone-conduction measurements are made with open ears; but if the tests are made with occluded ears, using an audiometer calibrated on occluded normals, a more valid picture of the "nerve" part of the mixed deafness wil result (Fig. 9). Confusion will be avoided so long as the possibility of "built-in occlusion" is borne in mind when open-ear tests are interpreted, and so long as the true occlusion effect is looked for. It is preferable, however, to avoid correction factors of this sort, whether applied mentally or otherwise, by recalibrating bone-conduction audiometers to give measurements relative to the occluded normal and by making bone-conduction measurements in the occluded state. Additional unoccluded tests should be made at 250 and 500 cps (providing the test room is quiet), the comparison of the two types of test serving to confirm or deny the presence of a middle-ear lesion. Bone-conduction tests at 2000 and 4000 cps give identical results whether they are made occluded or unoccluded; but in the occluded condition the tested ear will be considerably protected from the masking effect of ambient noise and the other advantages offered by an occluded bone-conduction test, in which a pair of air-conduction receivers can be left in position, will be enjoyed.

It must be emphasized that if a frontal bone-conduction receiver is to be used with

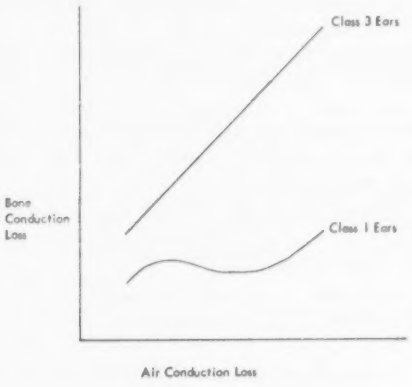


Figure 10

a standard audiometer whose bone-conduction test circuit is calibrated for mastoid tests the instrument must be recalibrated on a group of young normally hearing listeners.

The observations described have considerable bearing on the classical Weber tuning-fork test, and there appear to be a number of differences between the two types of test.

Several comments upon these disparities are appropriate:

1. My figures are averages, and the two ears of a subject with bilateral middle-ear disease may deviate from the average in opposite directions.

2. Tuning-fork tests are usually made in noisy offices, and the results may be more influenced by ambient noise than those of my audiometric tests.

3. At each of the five frequencies concerned, the air conduction-bone conduction relation of the Class-1 ears shows a tendency to follow the Class-3 curve until the air-conduction loss exceeds 10 or 20 db. (This tendency is shown stylized in Fig. 10.)

Summary and Conclusions

The occlusion effect resulting from the use of a pair of standard-type air-conduction receivers in association with a frontally applied bone-conduction receiver, and the relation between air-conduction and frontal bone-conduction hearing losses, were investigated on a group of 285 deaf and normally hearing subjects.

The subjects with normal middle ears showed average occlusion effects of 14.2 db. at 250 cps, 13.6 db. at 500 cps, and 3.3 db. at 1000 cps. The subjects with abnormal middle ears showed negligible occlusion effects at these frequencies. All ears showed negligible occlusion effects at 2000 and 400 cps. The magnitude of the occlusion effect is shown to be unrelated to the degree of air-conduction threshold loss.

Examination of the air conduction-bone conduction relationship indicates the following:

1. Cases with abnormal middle ears are in a constant state resembling that artificially produced by occlusion of an ear. In other words, increased or prolonged bone conduction is once again shown to be a reality and not an illusion.

2. Mastoid and frontal bone-conduction measurements give a picture complex of both cochlear and middle-ear functions.

3. The extent of the modification of this complex by middle-ear pathology (as exemplified by the Carhart notch) is probably dependent upon the degree of middle-ear change.

An occlusion effect demonstrable within the limits of my technique will indicate with a high degree of accuracy the presence of a normal middle ear.

That little is lost but much is gained in clinical bone-conduction measurements by occluding the ears and by using a bone-conduction receiver applied to the frontal bone rather than to the mastoid is demonstrated.

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Deafness and the Businessman

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Today it is possible for men and women who have lost all useful hearing to be successful in their respective businesses or professions.

This discussion is specifically directed to those adults who have lost all useful hearing and who come within the executive or professional categories. Persons included in this group represent a great unexploited pool of personnel talent, ability, and experience. There are many men and women who possess the requisite experience and ability for success in their respective fields, but because of lack of hearing they are presently retrogressing and their talent is going to waste.

The value of many of these people to themselves, their communities, their respective businesses or professions, and to their country could be greatly enhanced if they were merely shown the way.

There are few situations which cannot be overcome, and having undergone the experience of overcoming the handicap of deafness, I wish to bring out in this discussion those points which I feel will aid others in developing their potentialities. I wish to point out a few extramedical services which my experience has shown are of help and a few ideas we have worked out that are worth while. The problem which immediately comes to the mind of any one analyzing this situation is the present-day business requirement of telephone communication, but I can say unequivocally that this problem can be satisfactorily solved.

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William F. Wallace Jr. is a 38-year-old, 6-ft. 6-in. Texan, who has practiced law since 1941 except for time spent in the U. S. Army. Prior to Army service he had a 20 db. loss at 4000 and 8000 cps bilaterally. During Army service he insidiously lost all hearing above 2000 cps, with a slight impairment at 1000 cps. From 1945 to 1952 he specialized in oil and gas law with a very extensive practice, which was handled without any great difficulty in spite of the high-tone hearing loss. There was only a nominal amount of progressive hearing loss until 1951, when all hearing within the speech range was rapidly lost. Since then his hearing has completely deteriorated except at 250 cps, where his threshold is 75 db. Since 1952 he has diversified his activities, and is presently active as President of The Secondary Recovery Corporation of Texas (an oil company), and as an attorney, insurance man, and financing consultant. He has had training in auditory rehabilitation, and has made a remarkable adjustment.

The Physician and the Patient

There is no one who is as important to the hard of hearing patient as his physician. This is even disproportionately truer in the case of the deaf executive-professional man. Even to the otologist it should be reemphasized that in the business world, and particularly in the professional and executive fields, there are many positions where hearing itself is not a portion of the services rendered, but only a means used to transmit or receive information in order that the work itself may be conducted; further, deafness can actually be an aid in allowing concentration without distraction.

The message I wish to transmit through the physician to his patients is that regardless of the degree of loss of hearing it is possible to operate efficiently and profitably in nearly any business or profesion in which the person may be involved. (As noted in my personal history, within the speech range my hearing is absolutely nil.) Certainly the loss of hearing is as disabling to the practice of law as to almost any other profession or business. It is inevitable that certain adjustments will have to be made in the type of business, method of operation,

etc. However, it can be done. The physician must convince his patients of this point.

It is almost impossible for a person with normal hearing, even an otologist, to realize the impact of loss of hearing upon the person involved. His professional status, social intercourse, and economic, emotional, and physical security have been seriously impaired, and it is inconceivable that the patient can adjust to these things instantaneously.

It has been my experience that after the disabling loss occurs it takes a period of a few (three to five) years before the patient is able to master lipreading and the varied nonauditory techniques. Prior to this time he cannot expect to operate competitively in most phases of business or professional fields. There are, of course, certain exceptions (the dental profession and research come to mind).

It should be remembered that this discussion is limited to situations involving patients who have been active and successful in business or a profession. The first time at which the otologist may be of unusual service may occur at his earliest contact with the patient. At this time an effort should be made to evaluate the patient's prospective situation and determine, if possible, the time at which the hearing loss will become disabling. So long as a patient is able to operate on an aural communication basis, if given any encouragement at all, it is certainly a human tendency for him to feel that he will continue to be able to operate on that basis in the future and to handle his professional or business requirements without resultant loss in income. The physician should attempt to evaluate the emotional status of the patient and, within that limitation, make his prediction. He may not estimate correctly, but the possible service to the patient is great indeed and well worth the risk of error. Frequently, the business or professional man, if forewarned, may make drastic changes in his way of living and adopt a more conservative business and economic outlook in various respects which may greatly reduce the later financial impact.

Presuming there is close cooperation of the patient's family (the lack of such cooperation will inevitably make ultimate success by the patient infinitely more difficult), a periodic conference system should be arranged between the physician and the patient and the physician and the family. It is logical where the successful business or professional man is involved that the physician should act in this quasimedical capacity as another successful businessman who has a technical understanding of the problems presented. The ordinary social worker would not be qualified to advise nearly so well as the patient's physician in the period during or immediately after deafness occurs, when certain factors in the environmental condition of the patient and in the patient-physician relationship are of extreme importance if later rehabilitation is to be completely successful. The more successful the person may have been in his business or profession, often the more devastating will be the impact of the loss and the greater the fear of irreparable injury or damage to his business or professional practice. Possibly because such a disability frequently entails very serious immediate financial repercussions, I feel that patients will be much more concerned with the business or professional impact of the hearing loss than with the social. This, of course, is under the assumption that no attendant domestic difficulties arise at this critical time. It is very easy during this period for the person to lose faith in his ability to operate, either on a social or business level.

The continuing cooperation and exhibition of faith in the patient's ability on the part of the spouse and family of the patient is almost a prerequisite to success. This should be clearly distinguished from sympathy, an excess of which is certainly detrimental. Also, the assistance and cooperation of the person's primary business and social contacts are of great importance. The most critical relationship, however, is that of the

patient and the otologist, for it is to the physician, who is both the expert and a successful businessman, that the patient must turn for adequate advice and assistance in planning. It is during this period particularly that the physician can achieve what is possibly his greatest service by continually reassuring the patient that ultimately he will be able to operate satisfactorily in his business or profession, helping him to retain his faith in his ability to perform and, at the same time, emphasizing and trying to clearly show the patient that an extended interim period with varying adjustments must take place before it will be possible for him to operate with reasonable efficiency. The otologist also can be of great assistance in counseling the patient in regard to the particular problems of the patient's business or profession and in advising changes where necessary. This is particularly true in cases where the loss itself was sudden or there is a loss resulting from the transition from communication by ear to communication by other means. I want to emphasize that, although this special service conference arrangement will take a considerable amount of professional time, this should be charged for at the normal rate. No one can take the place of the otologist here, and for patients in this category no money could be better spent.

I have been one of the most fortunate of persons in having combined in my otologist a person of exceptional technical qualifications and, even more important, of outstanding personality attributes. He has given freely of himself, his time, advice, and understanding. Particularly in the light of some very unfavorable circumstances, it would have been impossible for me to have achieved what I feel to be complete rehabilitation without the unusually effective assistance and advice of my physician.

A Word to the Patient

Initially, there are two major facts which should be brought home to patients:

First. While it is definitely possible to ultimately attain a satisfactory operating condition, it can only be achieved as the result of many hours of drilling, work, and endeavor. In my own experience, I was fortunate in having a well-qualified lipreading teacher available in Corpus Christi who was of great assistance in helping me over the initial period. However, although these lipreading classes lasted for two years, such was only the beginning, and much additional drill is necessary. This drill may be achieved in various ways by the patient. Utilization of television and discussions (particularly with members of the family with whose lip movements he is familiar) on designated subjects or under abnormally difficult visual conditions will serve to develop the ability of the patient to operate under business conditions. It is very evident that the ability to read lips with a high degree of proficiency can not be acquired rapidly, but it can be acquired in time.

Second.—Patients should not underestimate what they can do, but it is equally important that they should have a realization of the inherent limitations of their disability under certain conditions. They should not butt their heads against a stone wall, e. g., consider the deaf music critic. Speaking from my own experience, prior to my hearing loss much of my professional duties had entailed attending conferences involving 8 to 15 persons, whereas under the present conditions this is manifestly impossible. The physician should advise his patients to expend their energies in developing the most advantageous situations.

Patients should realize that they will have to educate and convince the persons with whom they come in contact that they are able to operate in spite of this handicap. With this in mind, it is important to remember that whoever the contact may be he will remember the one time the deaf business or professional man "fell on his face" long after he has forgotten the 20 times the same person was able to operate efficiently and adequately under normal business conditions. Patients should try to operate within the scope of their capacities.

Once the patient has achieved a fairly efficient operating condition, he should attempt to handle his activities in such a manner that whenever he is forced to come in contact with more than one or two persons in a meeting he is serving in the capacity of chairman or moderator of such a meeting. Serving in this capacity will not only aid greatly in directing the flow of the conversation (itself an immense help in lipreading) but will also enable him to situate himself to advantage in the room to read more easily the lips of those present.

It is very important for the physician to pass on to his patients a realization of the physical limitations involved under the best and most effective operating proficiency. No person, regardless of physical capacities, has unlimited vitality, and it is certainly to be expected that the average age of the otologist's patients will be greater than my own. Operating on a nonauditory communication basis is the most depleting activity from a physical standpoint I have ever experienced. I frequently play two and a half hours of handball after leaving the office at 5 o'clock. Many times I have played 18 holes of golf on Saturday morning and an hour and a half of handball on Saturday afternoon, and I frequently engage in other sport activities equally as strenuous. However, although I am very fortunate in being in good physical condition and am gifted with exceptional stamina, an afternoon spent in a meeting or discussion entailing continual lipreading for long periods is far more fatiguing than any other activity I have ever experienced. It is standard procedure in the sociological rehabilitation of the deafened adult to urge such a person to be active in social life. This I think is highly desirable from both a business and a psychological outlook. Over a period no human being, living under the demands of present-day business activities, can handle a working day filled with lipreading activity and spend a full social evening entailing as great or greater requirements on his vigor and stamina. Therefore, a careful analysis should be made by the patient of all foreseeable demands. He must realize that aside from the physical limits of extreme exhaustion there is a marked loss of accuracy with fatigue. Thereafter, he must decide which demands he will fulfill and which activities must be foregone. The mental effort and concentration required for nonauditory "hearing" under intense and oftentimes highly competitive and difficult conditions will inevitably result in a certain amount of tenseness. When this is tied in with the normal amount of nervous strain arising from present-day business conditions, it becomes almost inevitable that a patient will encounter difficulty in being able to "unlax" at the end of the day. My experience has shown that physical exercise at the end of the business day is of very, very great assistance, much more so than social activity requiring more lipreading effort. Where both a hectic business day and a full social evening have taken their toll, I find a swim is the most beneficial means of relaxing both mind and muscles and inducing restful sleep.

My experience in business and in the practice of law has shown that the utilization of certain techniques will enable the deaf professional man and businessman to overcome certain problems involved.

Today I am completely without hearing within the speech frequency ranges, yet I daily talk over the telephone 20 or 25 times, and, in addition, make an average of from 8 to 10 long-distance calls a week. I have talked with people throughout the United States on long distance who have no idea that I have any hearing loss whatsoever, much less that I cannot hear at all. I believe that a description of this telephone technique would be of great value to many patients. Under the demands of modern business telephoning is an absolute necessity for patients if they are to operate competitively.

Needless to say, all the women (three to five) who work in my office have good speech mannerisms and are basically easy to

lipread. They articulate carefully, but not exaggeratedly, when in my presence and try to speak with an even flow that is at about average rate. The idea of the telephone technique occurred to me after viewing a court reporter in operation. Instead of taking the witness' testimony down in shorthand, the reporter was using a shielded microphone and repeated the testimony (word for word as spoken by the witness) into the shielded microphone for transcription upon a tape recorder. I experimented with the technique and found that with the assistance of a girl who is easy to lipread this technique could be adapted for telephone work, with exceptional accuracy. I try to maintain at all times at least two secretaries trained to operate proficiently in this manner.

There are two telephones on my desk. The one used by the secretary is a telephone furnished by the Bell System which has a button in the handpiece which cuts off the microphone on her telephone when it is depressed. Since two open lines sometimes result in low-powered reception, particularly on long-distance calls, I have had this handset placed on the amplifying instrument I previously used, which is on her side of the desk. On my side I have a standard phone. My secretary handles incoming and outgoing calls in the usual secretarial manner. When I prepare to take the call, she depresses the switch and cuts off her microphone. Thereafter, she repeats each word of the caller's conversation as it comes in. Of course, this requires a very definite technique, and I have found that it takes some four to six weeks for a girl to become adept at this operation. We have found that the secret of the girl's ability to handle conversations in this manner, particularly when the other person speaks rapidly, is for her to mechanically repeat word for word. She must not think of the meaning of what is being said. It must be remembered that proper names and figures out of context are as difficult to lipread under these conditions as normally. The girl sits on the opposite side of my desk facing me and has a pad in front of her upon which she prints as they come through any proper names or numbers which may be utilized by the other person in the conversation. In order to perfect this method of handling, I have learned to read upside down with a rather high degree of proficiency.

There will inevitably be an occasional person whose rate of speech approaches that of Walter Winchell, but even these persons can be handled adequately. However, these persons are the exceptions, and with a proficient girl there is not 1 caller in 20 with whom I encounter any more difficulty in conversation than does a person with normal hearing.

The girls learned that by attempting to portray the facial expressions, etc., as indicated by the tones of the speaker they are able to make lipreading easier. This I find to be of very definite assistance, particularly as the more animated speakers are those who are prone to speak most rapidly.

This technique probably has contributed more than any other single thing in allowing me to operate in a relatively normal manner. Before devising this technique I spent almost three years during which the only method of telephone communication was by means of the secretary receiving messages and delivering same to me. Naturally this was extremely unsatisfactory to my clients, my associates, and me.

A like problem arose in connection with interoffice communication with my personal secretary. A trip into my office each time I wished to discuss something was resulting in a very excessive loss of time. This was remedied by inserting a plate glass panel in the wall between our offices. Even though the distance is some 20 ft., little difficulty is experienced in lipreading at that distance, and much time is saved. As an actual benefit she can transmit messages to me when people are in the office without disclosure of confidential information.

It should be kept in mind that so far as office operations are concerned, the

deafened person may function much more efficiently as a leader than as a subordinate. In any business continual contact with the public must be considerable. Given the opportunity (and presuming that the requisite ability and experience are present), the deafened person may act as executive (and indeed will of necessity function more efficiently as an executive than the ordinary person). For the deaf person to operate efficiently in this respect, it will be necessary that he select and utilize to the fullest extent capable subordinates to act as department heads or operating division heads. Much of the necessary public contact may be handled by them. Always keeping in mind the limitations of his physical capacity, the deafened person will find it is important to utilize primarily frequent memoranda and reports, supplemented by occasional conferences, to keep in touch with and control over operations.

There are many techniques which we have worked out to cope with specific situations. Space does not permit their inclusion, but ingenuity will allow patients to operate competitively and efficiently in nearly every situation, for it can be done. The otologist has an opportunity for exceptional service with this group.

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Case Reports

Removal of Esophageal Foreign Bodies by the External Approach

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Foreign bodies in the esophagus can be removed in two ways—either by endoscopy or externally through the neck or thorax. Most foreign bodies which lodge in the esophagus should be removed by esophagoscopy, but when, for any reason, that method cannot be used, the alternative is the external approach, described by Marschik,[1] Schlemmer,[2] Björk,[3] Head,[4] Phillips,[5] Flett,[6] and Huizinga.[7] This procedure is extremely valuable, either for foreign bodies still in the upper half of the esophagus or for those which have perforated through the esophagus into the mediastinum.

For the past few years little has been written about the external approach. Apparently it has fallen into disrepute due to the frequency with which mediastinitis formerly accompanied the procedure. The operation can be safely done now, and, with antibiotics, produces gratifying results.

Report of Cases

To illustrate, on Dec. 25, 1950, I was called to see a 10-month-old boy who had swallowed a penny 10 days previously. His doctor assumed that it had passed into the stomach because he was asymptomatic. No x-rays were taken at that time. The child was starting to run a low-grade fever and seemed listless; so an x-ray was taken the day before I examined him. This film (Figure) revealed a disk-shaped foreign body in the midline of the upper chest at the level of the first rib. There was pneumothorax on the left and a suggestion of air in the mediastinum. The boy was prepared for esophagoscopy, and under ether anesthesia the esophagoscope was passed. No foreign body was found within the lumen of this structure. Out of fear that the relaxation incident to the anesthesia might have permitted the foreign body to pass into the stomach, a portable x-ray was taken, which revealed the same opaque coin in the mediastinal region. A repeat esophagoscopy was done, and at the level of the coin a few milk curds could be seen in a slit along the left lateral wall of the esophagus. It was not feasible to pass an instrument into this area; therefore the esophagoscope was withdrawn and arrangements were made to remove the coin by the external approach.

The technique used is the one outlined in Callander's[8] "Surgical Anatomy," under the heading "Presternomastoid Esophagotomy Approach." A 5 cm. incision was made along the anterior border of the left sternocleidomastoideus muscle at its lower aspect. The deeper structures were separated until the thyroid was visible. The inferior thyroid artery was ligated and cut. The body of the thyroid was retracted medially; the carotid and jugular vessels were retracted laterally. With the use of blunt dissection, the field was extended down to the area adjacent to the esophagus. Considerable inflammatory reaction was noted in this region. By palpation, the metallic disk could be felt. An incision was made directly over the object and the penny was found at the site where esophageal diverticula often form. The deeper structures were then closed with white cotton, the muscles approximated, and the skin closed. A ¼ in. Penrose drain was placed in the wound, and a dressing was applied. The patient's postoperative condition was good, and two days later the drain was removed. No mediastinitis developed. The child was given 300,000 units of procaine penicillin G intramuscularly twice daily for two days. To the satisfaction of all concerned, he recovered fully.

The assistant at this operation, Dr. Claude E. Randolph, later went as a medical missionary-director to Southeast Asia. While in the Philippines in 1953, he, too, had a patient—a 2-year-old boy—who had swallowed a coin. This was a 5-centavo piece. The x-ray revealed that the coin was located in the esophagus, in the region of the

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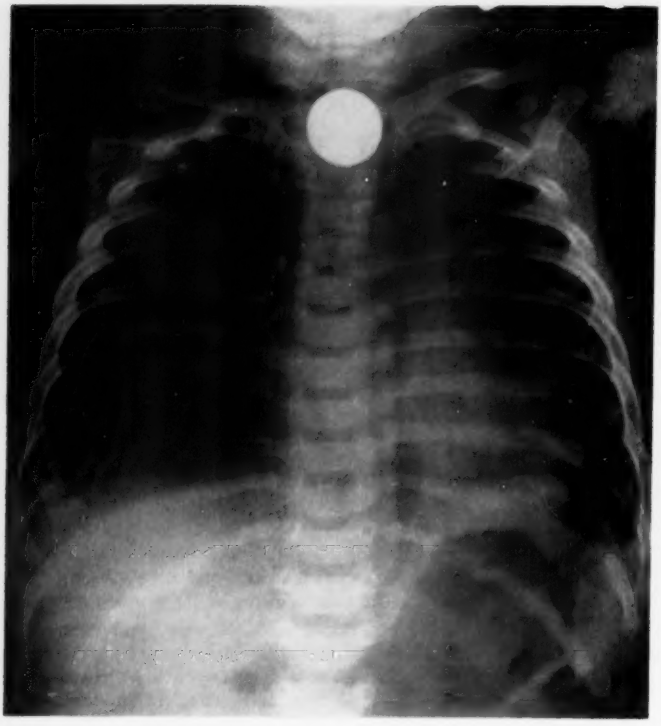

A disk-shaped foreign body is seen at the level of the clavicle. Pneumothorax is present on the left side, and there is evidence of air in the mediastinum.

third, fourth, and fifth cervical vertebrae. The coin was removed, with use of the same approach. The only complication which arose was the breaking down of the wound and leakage of the esophageal contents to the exterior. The condition was corrected by tube feeding for a short period of time. The child made an uneventful recovery and was discharged from the hospital on the 13th postoperative day. Dr. Randolph is recommending this operation to other medical missionaries serving in Thailand, Viet-Nam, Taiwan and other areas of Southeast Asia.

Summary

The external approach for the removal of foreign bodies from the esophagus and mediastinum is reviewed. Two cases are presented in which this approach has been used, and the indications for the procedure are outlined.

233 "A" St.

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Progress in Otolaryngology

The Paranasal Sinuses

Summaries of the Bibliographic Material Available in the Field of Otolaryngology for 1954-1955

SAMUEL SALINGER, M.D., Palm Springs, Calif.

The material included in this Review represents practically all of the listings obtained from the "Current List of Medical Literature" of the National Library of Medicine covering articles that appeared during the years 1954 and 1955.

Anatomy, Physiology, Pathology

Jovanic, Lotric, and Radojevic[1] studied specimens of the sphenoid bone in the young up to the age of 20. The sinus develops in two stages; in early childhood it is beyond the body of the sphenoid in the turbinal of Bertin (sphenoid turbinal), which is closely in apposition with the anterior wall of the bone. In the second stage there is a partial absorption of the ossicle of Bertin with resorption of bone in the body of the sphenoid. According to the authors, the transition from paleosinus to neosinus takes place in the fourth year. Other authors have stated it to be in the sixth year.

The paleosinus is cone-shaped, its base, directed forward, containing the ostium. The orifice is round in 85% of cases, oval in the rest. The opening is in the ethmosphenoidal recess, which is wider in children than in adults, thus accounting for its ready accessibility. In infants the opening is situated lower down than in adults. With extension of the paleosinus into the body of the bone, the sinus may achieve extensive expansion. At first the expansion is upward and laterally, and later medially toward the intersinus septum; finally it develops downward. At about the fifth year the sinus occupies more or less the body of the bone in the form of a prism. Asymmetry has been noted as early as the fourth or fifth year. Although the shape of the sinus at this period is much like that of the adult, it may still continue to expand with prolongations into the orbital apophysis of the palatal bone and into the pterygoid process.

Drexler[2] studied the configuration and structure of the temporal fossa and external wall of the orbit in 280 skull specimens. He found wide variation in the degree of participation in this wall on the part of the greater wing of the sphenoid and the zygomatic bone. The linea innominata is explained as the tangential projection of the compacta bent into the fossa temporalis. This line may be made up of several adjoining bones to varying degrees. The constant lower termination of the linea innominata is identified as the infratemporal spine of the ala magna. These points are of some value in the reading of x-ray films.

Varveri[3] made radiological and direct observations in a series of 80 adult skulls to determine the morphology of the maxillary sinus. He found that the sinus presents four surfaces, seven borders, and four recesses, all of which are described in detail.

The orbital and canine surfaces, for example, are triangular in shape, whereas the infratemporal or posterolateral surface is quadrilateral. The capacity of the sinus was found to range between a minimum of 12 ml. and a maximum of 29.5 ml. The

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variations were in no way related to age, sex, septal conformation, or the presence or absence of teeth in the inferior alveolar arch.

Rosen and Sarnat [4] sectioned sagittally the skulls of 10 healthy dogs, filled the maxillary sinuses with a low-fusing metal, and from the casts computed the volume of the respective sinuses. In five of the animals the difference between the two sides was less than 3%. In the remainder, it ranged from 7% to 15.3%. There was little preponderance in favor of either side. It was concluded from these studies that there was no significant difference in the volume of the antrums between the right and left sides in individual dogs.

Because of reports that the volume of the maxillary sinus may either increase or decrease in size after extraction of teeth, Rosen and Sarnat [5] conducted an experimental study on dogs to determine whether such was the case in the animal. Ten animals with complete dentitions were used. The upper left third and fourth premolars and first and second molars were extracted in seven, and the entire superior left quadrant of teeth in the other three. The animals were killed 6 to 12 months later and, after the skulls were sectioned, the maxillary sinuses were filled with a low-fusing-point metal. Measurements of the casts showed that the sinus on the edentulous side was larger than the treated sinus in eight dogs by from 6.8% to 27.1%.

Discussing the clinical application of this experiment, the authors suggest that alveolectomy be performed preferably at the time of extraction rather than at a later date, the reason being that the "loss of maxillary posterior teeth many years before the need for a complete artificial denture may allow excessive pneumatization of the maxillary tuberosity by the antrum if the correction is left until the later date."

A developmental anomaly of the frontal bone in a woman of 70 is described by Hiltemann.[6] The chief complaint was frontal headache. X-rays revealed a hyperostosis frontalis interna, persistent frontal suture, and metopic fontanelle. There was a butterfly-shaped area of bone absorption visible in the frontal view at about the center of the forehead. The frontal sinuses were underdeveloped, in contrast to the markedly pneumatized ethmoids. The author assumes that a genetic factor was dominant in this case, similar to that which causes situs inversus, spina bifida occulta, and cleft palate, with which it may appear in conjunction. However, he does not entirely eliminate the possibility of an endocrine dyscrasia.

Schroer [7] demonstrates the network of the vegetative nerve apparatus in the tunica propria of the sinus mucosa in some beautifully illustrated sections. It is a nucleated plasmatic end network shot through with neurofibrils set in a delicate terminal reticulum. Fine branches from the intercalary cells are occasionally seen, but in cases of hyperplastic seropolypoid mucosa, both formations are more readily demonstrated. It is assumed that these findings indicate participation of the nerve elements in the general hypertrophic process. In the suppurative cases the changes in the nerve elements are more pronounced; nerve fibrils are thickened, occasionally granulating, neurofibrillar masses break down, and vascuolation is in evidence.

It is evident that this vast network of nerve fibers originating in the sympathetic and parasympathetic ganglia are responsive to every conceivable normal and pathological process taking place in the mucosa.

Kelemen [8] continued his studies of experimental animals by sectioning the heads of 11 albino rabbits, as he had done previously with rats and guinea pigs. Seven of these presumably healthy animals showed infection of the respiratory part of the nasal cavity. Empyema of the maxillary sinus was found in eight and infection in the olfactory area in eight. These results would indicate likely sources of error when experiments are performed on these animals, particularly with reference to the action of drugs whose effects are being studied. Also, certain anatomical conditions in these ani-

mals preclude the possibility of drawing conclusions from certain experiments. The rat and the guinea pig have a fenestrated septum which virtually makes one cavity of the two sides. Therefore, one cannot use the "untreated" side for comparison with only one side in the experiment. In the rabbit the respiratory part is a separate unit, its secretions draining into the pharynx without reaching the posterior or olfactory area.

Zilstorff-Pedersen [9] examined the sense of smell in five experimental subjects, all trained in olfactory threshold determinations. The sense of smell was tested by the Elsberg technique 15 to 20 minutes before partaking of a luncheon and then re-tested immediately after for a period of 90 minutes at intervals of 10 minutes. Elsberg's olfactometer was employed with a difference of 0.25 ml. in the various stimuli, alternating from one side of the nose to the other every 30 seconds.

The result of the experiment demonstrated "that there was no systematic alterations of the threshold values in connection with the meal consumed."

Zilstorff-Pedersen,[10] continuing his studies in olfaction, tested 100 normal persons with the object of determining whether there are spontaneous variations in the sense of smell. Elsberg's method was employed, which in principle "consists of injections of variable but measurable volumes of odorous air into the nasal cavity of an individual during a period of momentary cessation of breathing." Tests were done in the same room, temperature about 20 C, humidity 45%-50%, and at the same time of day. The subjects were then weeded out until five of the most reliable were selected as most suitable and reliable. The vast majority of subjects examined wavered too much in their statements, which made it difficult to obtain a period of constant threshold values. Care was taken to avoid recordings if the turbinal tissues were swollen enough to interfere with the passage of inspiratory blast into the olfactory region.

The net result of the experiment was to show that the threshold values remained constant in 58% of the experimental period. In the other 41% it was found that the threshold rose or fell to about the same degree.

Eickoff [11] made histologic studies of 182 specimens of mucosa removed in Caldwell-Luc operations. His purpose was to try to see if he could evolve a classification of histopathologic forms which would indicate the character of the process. His conclusion was that it was impossible to set up a systematic classification. The reasons set forth are, first, that the mucosa even under normal conditions shows wide variations; second, because the transition from the acute to the chronic stage is not a regular one and, third, because some of the changes seen may be attributed to the trauma inflicted by sinus punctures and irrigations. Fibroblasts may appear early, and edema may persist into the late stages. Serial sections rarely show a pure form of acute or chronic catarrh or inflammation. All types of tissue reaction may be seen in the same specimen. Therefore, on the basis of the histologic appearance of the specimen, one cannot always label the process "acute" or "chronic."

Sullivan, Thompson, and Foster [12] call attention to artifacts which may develop in the cultures on solid media of turkey sinusitis and chronic respiratory disease. These resemble the PPLO (pleuropneumonia-like organism) for which they may be mistaken. It was found that these pseudocolonies are derived from soap crystals formed from the serum in the media. The authors conclude that "the use of serum-enriched solid media for the cultivating of PPLO has definite limitations."

Diagnostic Procedures

Kustner [13] enumerates the various conditions which may be diagnosed with the aid of contrast filling of the antrum. These include anatomical variations, hyperplasia, polypi, cysts, carcinoma, and odontogenic in-

fection. The article is well illustrated with a number of x-ray pictures and histologic sections.

Sichel, Wild, and Voegthlin [14] found that planigraphs afforded better visualization and localization of ethmoidal mucoceles than standard projections. Two cases in point are cited.

Schlosshauer [15] again describes the technique of the overtilted or inverted axial films for demonstrating pathology in the frontal sinuses. Since the film is taken with the patient's head in extreme extension, the procedure is not applicable to elderly persons or patients with arthritis or other spinal deformities. This projection throws the teeth of the upper jaw toward the top of the picture above the sinus cavity, which is outlined as seen from below. Three distinct bony lines indicate the lower orbital margin, the anterior wall of the sinus, and the posterior wall in that order. This procedure is very helpful in demonstrating empyemas, cysts, aplasia, and varying bony densities.

The author also recommends enlargements of the films for the detection of early signs of bony destruction in osteomyelitis.

Schlosshauer and Mockel [16] made blood determinations in 21 cases where the maxillary sinus had been filled with a contrast solution. The purpose was to ascertain the amount of absorption of iodine. The solution employed was a pyridone-iodine combination called Perabrodil (equivalent to iodopyracet U. S. P.). Mostly a viscous mixture was used, although in a few cases it was a watery solution. Blood samples were taken, 2, 5, 10, and 15 minutes and a half-hour, one hour, one and a half hours, etc., up to five hours following the instillation. The blood concentrations varied according to the status of the mucosa and the sufficiency of kidney function. Thus when the mucosa was normal the blood level reached a maximum of about 0.25 mg. per 100 ml. within an hour for about four hours, disappearing after five hours. In cases of renal insufficiency the levels increased gradually, reaching a height of about 0.7 mg. per 100 ml. at the end of four hours. When the antrum mucosa was polypoid, the concentration reached a maximum of 1.3 mg. per 100 ml. in the third hour, falling rapidly to zero after five hours.

The rate at which these levels were attained was more rapid with watery solutions than with viscous solutions.

Compared with the absorption observed when the solutions were used in pyelograms, bronchography, and urethrocystoscopy, the percentages in the antrum-filling cases was the lowest.

The conclusions were that, aside from an occasional case of allergy to the medicament, there was no danger of undue amounts being absorbed into the blood stream.

Gerke's book [17] is by a man who has written extensively on the relationship of the teeth to the antrum. It covers the anatomy of the region with its manifold variations, the various x-ray projections he has evolved to show the relationship of the teeth to the floor of the antrum, and examples of pathology as demonstrated by these methods.

DeLuca and Massimeo,[18] reporting a case of spindle-cell sarcoma of the medial wall of the orbit, go into great detail to describe the particular projection they used in the planigraphs. This projection is one which brings the sphenoid fissure in a line at right angles to the principal ray, thus demonstrating the details of structures adjoining it.

Skull sections, diagrams and sample planigraphs bring out the salient points.

Wild, Sichel, and Klotz [19] had two cases of ethmoid mucocele, the diagnosis and localization of which were greatly facilitated through planigraphs. One case gave a history of having had a mass removed from the orbit, diagnosed at the time as a meningocele. This was in early childhood. There were no symptoms following until the patient reached the age of 29, when a mass developed at the internal orbital angle close to the site of the previous operation. It proved to be a mucocele which the authors

feel was a recurrence of the growth, supposedly a meningocele, previously removed.

The other case was a huge affair eroding the orbital walls, which showed up nicely in the planigraphs.

Fischgold, Metzger, and Kovach [20] demonstrate a technique in planigraphy designed to visualize the petrospheno-occipital area of the base of the skull. It is almost the same head position as in the Stenver projection. The diagram, anatomical cut, and x-ray pictures bring out the details clearly.

Four illustrative cases are cited with localization of two neurinomas and two malignant metastases.

Boxer [21] shows pictures of four cases where the disposition of a fractured displaced tooth root was in question. These demonstrate the errors that may arise in the interpretation of pictures taken at incorrect angles. Avoidance of projections which cause the shadow of the malar bone to overlie the suspected areas is one of the important items in proper roentgenography.

Cavallot and Monateri [22] claim that for exact diagnosis one must frequently combine several x-ray procedures, such as contrast media, planigraphy, and stereoroentgenography. They stress particularly the value of planigraphy, especially in the diagnosis of odontogenic cysts.

Janos [23] recommends the overextended head position for taking the axial projection picture to show the frontal sinus as it appears from below. It is useful in differentiating the degree of involvement in the two sinuses separately, in showing aplasia clearly, in demonstrating changes outside the sinus walls in chronic inflammation, and in delineating the intersinus septum.

Payrau and Benois [24] discuss the question of accurately diagnosing the position of an ethmo-orbital osteoma by various roentgenographic procedures. In the particular case they cite it was important to decide whether the mass had penetrated into the cranial cavity, because the surgical procedure would depend on this point. The decision would have to be made between an external ethmoidal approach and a transfrontal craniotomy. Although the planigraphs seemed to indicate a break-through, the stereoroentgenograms definitely ruled it out, and as a result the ethmoidal approach was used and the mass easily removed from the orbit, whose cranial wall was shown to be intact.

The authors cite Chausse, who described the technique of stereoradiography at the Saragosse convention of the Latin Oto-Rhino-Laryngologic Association in 1952.

Hahn [25] describes an antroscope which measures only 2.2 mm. in diameter and is passed through an antrum cannula whose diameter is 2.5 mm. The eyepiece is large by comparison, measuring 2.5 cm. across. The angle of vision is set at 90, which the author considers an advantage when inspecting the alveolar recess. He claims it is possible to locate displaced tooth roots more accurately than by the x-ray, which is sometimes an advantage so far as the therapy to be employed is concerned. This is illustrated in a case where the tooth fragment had not penetrated into the antrum but was lying just below the mucosa. The author points out various diagnostic features observed through the scope, which indicate types of pathology.

Nehls [26] recommends an antroscope made by Fischer, Pfau, and other German firms with an angled optical system permitting one to inspect all the recesses of the antrum. It is introduced through a cannula via the inferior meatus. In addition to its value in the diagnosis of lesions within the antrum, it is useful in localizing foreign bodies and displaced tooth fragments and also in the follow-up cases operated on by the Caldwell-Luc technique.

Another apparatus for endoscopic examination of the maxillary sinuses is described by Aleksashin.[27] This has a camera attachment to a 2.1 mm. cannula fitted with an optical system whereby the interior can be photographed.

Hoas [28] suggests a modified posteroanterior projection for the frontal sinus. The usual posteroanterior and anteroposterior projections superimpose the parietal tuberosities over the lateral walls of the frontal sinuses. To show the lateral areas of the frontal bone without overlying bony shadows, the author recommends moving the tube more anteriorly, so that the "central ray enters the skull slightly posterior to the bregma and passes through the midpoint of a horizontal line through the supraorbital ridges."

A case in point is cited, proving the superiority of this technique in delineating an osteogenic sarcoma which was not suspected from the routine picture.

Complications

Intracranial, Osteomyelitic, Orbital, Pulmonary

Kaser,[29] reporting four cases of his own, cites Borries, who gathered 73 cases from the literature on the subject of nonsuppurative encephalitis due to otitic or sinus infection. They envision the process as being one or two stages short of abscess formation—that is, the stage of hemorrhagic nonsuppurative encephalitis succeeding the initial stages of edema and simple inflammation. The symptoms are practically the same as in brain abscess, although it has been noted that frequently the onset is marked by high fever, which is not the case in brain abscess. Furthermore, the spinal fluid reveals wide changes in the cell count and pressure.

It is recommended that when symptoms appear which suggest brain abscess, one should delay a few days to give the supposed abscess a chance to encapsulate. However, if surgery is indicated for the removal of the sinus focus, the improvement that follows can in most cases rule out an abscess of the brain. Nevertheless in some cases the recurrence of brain symptoms is an indication for further exploration and, in one of the cases reported, a subdural abscess was found. In another case, recurrence of epileptiform seizures some months later was attributed to scar formation and nothing further was done.

The author cites Borries as having found that only 5 of the 73 cases studied ended fatally.

The case reported by Whitten and Moyar [30] "illustrates the fact than an infection of low virulence, in the epidural space, can exist for a period of years (in this case 12 years) without outward signs of its presence." The patient had had a frontal sinusitis with osteomyelitis at the age of 13, at which time the sinus was drained through an opening in the floor and the osteomyelitis treated through a second incision over the fluctuant mass. It was also noted at the time that both tables of the bone were eroded, for which the area was curetted. There were no symptoms until 12 years later, when the patient had a severe attack of headache, nausea, and vomiting. Examination revealed a homonymous hemianopsia, papilledema, and osteomyelitis. A craniotomy was done and a large area of thickened eburnated bone was removed. An epidural abscess was found and the dura was covered with granulations. The organism recovered was a nonhemolytic coagulase-negative Staphylococcus aureus.

Lemieux [31] describes a case of subdural abscess due to a frontal sinusitis. The classic symptoms of cerebral involvement were all present, such as severe headache, vomiting, semiconsciousness, Kernig's sign, stiff neck, convulsions, and monoplegia. Since there were symptoms of compression of the brain stem and the patient was almost moribund when examined, no surgery was performed. The autopsy showed a large subdural abscess with extensive fibrinous exudate over the entire hemisphere, thrombosis of the superior longitudinal sinus, and herniation of the brain in the hippocampus region, with displacement of the brain stem. The frontal sinus on the affected side was filled with pus and granulations.

Biehl [32] reports four cases of subdural empyema due to acute frontal sinusitis, describing the pathogenesis, clinical mani-

festations, and diagnosis. He emphasizes the importance of early diagnosis, since these cases offer a favorable prognosis if operated upon promptly. Antibiotics are of great value but cannot be expected to cure the patient unless early drainage is instituted.

The author points out that subdural empyema may arise in two groups of patients, namely, those with acute fulminating sinusitis and those with meningitis. Generalized headaches, vomiting, chills, changes in sensorium, cranial nerve palsies, and focal neurologic signs indicate intracranial spread. This also applies to the appearance of orbital infection.

Nonhemolytic streptococci have been found to be the most frequent offenders, and penicillin with streptomycin should be given in adequate doses until sensitivity tests have been completed.

When symptoms of meningitis appear, the spinal fluid will reveal a high leukocyte count but the fluid is almost always sterile and the sugar content normal. X-ray pictures are of value only in demonstrating the sinus involvement. However, if osteomyelitis is present or erosion of the posterior plate can be demonstrated, the pathogenesis becomes even more clearly defined.

A case of frontal cholesteatoma with pneumatocele and perforation into the lateral ventricle is reported by Philippides.[33] This 35-year-old man, suffering mild headaches with a slight exophthalmos but no impairment of vision for two years, suddenly developed violent headaches and vomiting. X-rays showed a large defect in the area above the brow and in the ethmoids. Also an air-filled cavity was seen in the roof of the orbit, communicating with the frontal and ethmoid sinuses. This cavity extended backward to the ventricle. Also there appeared to be a mass along the posterior wall of the frontal sinus.

The area was exposed via an osteoplastic flap, revealing a cholesteatoma between the bone and the dura. After removal of the mass a fistula was found in the dura about 2 cm. in length. The posterior wall of the frontal sinus was completely destroyed. Also there was a defect in the roof of the orbit. The fistula led into the cavity filled with air and fluid.

The patient recovered, although a second operation had to be performed because of an infection with persisting drainage.

Oculo-Orbital

Cordier[34] attributes the reduction in the incidence of oculo-orbital complications of sinusitis in recent years to the widespread use of antibiotics in upper respiratory infections. Because of the relative infrequency of these complications, the author felt impelled to review the situation in order to clarify some points bearing on the pathogenesis and classification of these complications. This he does quite adequately, beginning with the anatomic factors, means of propagation of the infection, and going on to describe infections in the anterior segment of the orbital cavity, involvement of sensory and motor nerves and, finally, involvement of the posterior portion of the cavity, the optic nerve and blood vessels. There is nothing new in the presentation. The author concludes by stating that these conditions are more common than generally believed, and since the vision may be irreparably damaged in some cases, it is important that the rhinologist and ophthalmologist collaborate with the x-ray man in the best interests of the patient.

Everberg's case[35] was an interesting one in which the optic neuritis was diagnosed as being due to a mass which, from the x-ray pictures, appeared to originate in the hypophyseal region. The pictures showed extensive destruction in the sella and the upper portion of the optic foramen. The sphenoid intersinus septum was absent. Nasal examination was negative. An exploratory craniotomy revealed an area measuring 15×8 cm. anterior and medial to the optic foramen, where the underlying bone was missing. The area was soft and shone greenish through the dura. It was then assumed that

the tumor originated in the orbit, which was opened but found to be normal. It was then concluded that the greenish area below the eroded bone must represent the roof of the sphenoid sinus. The patient was then subjected to an intranasal trans-septal sphenoidotomy following the technic of Spiess. The sinus was found to be filled with almost 10 ml. of brownish-green thick odorless pus. It apparently was a cyst. The sinus mucosa was reported to be the seat of a chronic inflammation.

Following the surgery the patient began to show improvement in the vision. However, this was not sustained, and eventually the optic nerve atrophied.

Discussing the question as to whether the craniotomy was justified, the author claims that ophthalmological and x-ray findings all pointed to the hypophysis. However, he concedes that pictures of the sphenoids taken from other angles might have shown definitely that the mass originated in the sinus. However, in view of the fact that the pictures revealed extension into the cranial cavity, it still would have been proper to approach it via a craniotomy, even though the sphenoids were shown to be involved.

The two cases reported by Pecker and Pialoux [36] present some points of interest from different angles. The first was a case of ophthalmoplegia in a woman of 28, of six months' duration, intrinsic paralysis with mydriasis, and reduction in visual acuity. Because of the history of sudden onset and severe headaches, it was thought possibly the condition was due to a meningeal hemorrhage. However, lumbar puncture and arteriograms were negative. Although the sinuses appeared normal in the x-rays, suspicion was directed to one antrum because of slight discharge and swelling of the middle turbinate. Irrigation of the sinus yielded some mucopus which cultured a Staphylococcus. Since this afforded some relief, the sinus was operated upon and the mucosa was found to be thickened and inflamed. The improvement was immediate, and within six months the eye returned to normal.

The second case was in a man of 56, whose symptoms suggested a tumor in the region of the sphenoidal fissure. The ophthalmoplegia was complete. The antrum was opened and the mucosa found to be hyperplastic. Unfortunately, the specimen was lost. However, there was immediate improvement in the headaches and the paralysis. This was short-lived, the original symptoms returning in six months and, from the examination, it appeared that the original diagnosis of a tumor of the base was correct even though the temporary relief obtained was due to the superimposed sinusitis having been uncovered.

Bouchet, Pialoux, and Pecker [37] describe a case of maxillary sinusitis which produced the following ocular symptoms: complete ptosis, immobility of the bulb fixed at the external angle, and midriasis. When irrigations of the sinus failed to relieve the ocular condition, the antrum was opened but revealed little pathology beyond some thickening of the mucosa. The ethmoids, which were then entered, also failed to show much change. The frontal sinus and the sphenoid were opened for drainage. Biopsies taken from the antrum and ethmoids showed inflammatory reaction in the former and were negative in the latter. Nevertheless, the following day the patient was relieved of his pains and within a few days all the ocular disabilities disappeared.

Vogel's item [38] is a short summary of orbital and intracranial complications of sinus disease, for the benefit of general practitioners, and covers only the high points.

Bronchopulmonary

Gudbjerg [39] found records of 25 cases of dextrocardia at the University of Copenhagen during a period of 12 years, and in none of these were there any evidences of bronchiectasis. It would appear, then, that the association of dextrocardia with bronchiectasis is not as frequent as described by others.

On the other hand, 35 patients with bronchiectasis were examined for possible

sinus involvement, which was found in only 10 cases. The author is inclined to consider the sinusitis as the result of the bronchiectasis rather than the cause.

Also, he does not believe that bronchiectasis is congenitally acquired. He explains the association of bronchiectasis with dextrocardia as being due to impairment of the circulation from the transposition of the heart and major vessels.

In a lengthy article replete with references to the literature, Neuberger [40] attempts to resolve the difference of opinion between the proponents of the endogenous factors in the relationship between sinusitis and bronchiectasis. He believes that the congenital factors play the most important role. Statistics show that the incidence of bronchiectasis in the vast number of chronic sinusitis cases is very small, whereas the incidence of sinusitis in bronchiectatic cases is large. The reason assigned by the author is the relative immaturity of the sinuses from the phylogenetic standpoint, compared with the lower respiratory tract. This fact, in the author's opinion, leads to the conclusion that the latter possesses greater resistive powers to exogenous influences than does the former.

Mounier-Kuhn, van de Calseyde, and Mrozowski [41] conceive the syndrome of Mounier-Kuhn as a combined involvement of upper and lower respiratory tracts in which the ethmoids and antrums are infected, along with chronic bronchitis and bronchiectasis in various degrees of advancement. They believe that the condition is based on a hereditary factor, which in some cases is much more pronounced and may lead to the development of a Kartagener syndrome. It begins at an early age, when the development of the sinuses and the bronchial tree is still immature. This terrain, being congenitally weak, offers a fertile field for the inception of an allergy which is a potent factor in many of these cases.

Lustig [42] asserts that many cases of asthma can be greatly relieved, if not cured, by proper attention to the diagnosis and treatment of concurrent sinusitis. Frequently the sinus condition is more or less latent and unrecognized. Diagnosis depends on the history and properly taken x-ray pictures. The author cites eight cases briefly.

The treatment consists of displacement with antibiotics that are selected according to sensitivity tests carried out on the offending organisms. Therefore a variety of drugs was used in these cases, among them penicillin, streptomycin, oxytetracycline (terramycin), and chloramphenicol (Chloromycetin). Aerosol therapy was also employed. The author claims that definite improvement of the asthma was observed in all the cases.

Ceci [43] made a study of asthma secondary to sinusitis which resists routine therapy. The author recommends Ramond's desensitizing treatment, which consists of a series of intramuscular injections of a solution made up of turpentine and 60% alcohol, 2.5 gm. each in 100 ml. of isotonic saline. The solution is sterilized and divided into 20 ampules without filtering. The initial injection is 1 ml. which is increased by 0.5 ml. every six days until an urticarial wheal is obtained. However, if this therapy fails and the mucosal changes are far advanced, the author recommends surgery, preferably the deLima operation.

Goldman, et al.[44] made a thorough study of 82 cases of asthma, 58 intrinsic and 24 extrinsic, which included the history, bacteriologic, roentgenographic, and micropathologic examinations. Thirty-one cases had a radical antrum operation, and thirty were treated by more conservative surgery. It was revealed that "definite improvement of the asthma occurred twice as often in the group without removal of the antrum membrane, although only a minority of patients were benefited in either group."

The authors conclude that sinus infection is not the cause of asthma but, rather, a superimposed secondary infection on a basically allergic membrane.

Osteomyelitis

Morrison [45] reviews the history, etiology, and present-day status of the therapy of

osteomyelitis. The intelligent use of antibiotics has made it possible to withhold surgery until such time as the process has been limited to a definitely prescribed area. Thus much radical surgery has been avoided. Technics have changed as a result; yet it is always advisable that the dura over both frontal lobes be exposed to assure the absence of epidural abscess. Emphasis is laid on the necessity of providing adequate surgical drainage. "An abscess cavity filled with purulent material has no blood supply," and it is self-evident that antibiotics cannot be effective unless the blood supply to the affected area is adequate.

In the case reported by Burger [46] the x-ray pictures failed to show any involvement of the bone in an osteomyelitis that developed about two weeks after an acute upper respiratory infection. Early edema of the lids and forehead disappeared under antibiotic therapy but soon reappeared. At the same time the antrum was operated upon for the infection, which was demonstrated in the Caldwell-Luc procedure. The frontal swelling soon became fluctuant, and an operation disclosed an abscess with destruction of the outer table and diploetic structure in an area of about 6 cm. across. The inner table was intact and was not opened.

The author comments on the absence of x-ray findings and cites other references in the literature bearing on this point.

Chick, Printz, and Borak [47] report a case of tuberculous osteomyelitis in a 6-year-old child with a slowly developing mass in the infraorbital area lateral to the eye. It looked like a cellulitis. The swelling was incised and drained. When the fistula failed to heal, the draining secretion was examined, revealing acid-fast organisms. X-rays showed an area of destruction in the malar bone, and further examination demonstrated active tuberculosis of the lung and several thoracic vertebrae.

Sinusitis in Children

Eckert-Möbius [48] covers the important points regarding the development of the sinuses at various stages in children and refers to the work of J. Koch "Critical Review of Normal and Pathologic Pneumatization of the Nasal Sinuses" (*Arch. Ohren- Nasen- Kehlkopfh.*, 1930), which was quite comprehensive.

Sinus infections in children differ but little from the adult type but are of more frequent occurrence for the following reasons:

1. Relative thickness of the mucosa; long and narrow ostiums
2. Adenoid hyperplasia which interferes with adequate ventilation
3. Endocrine and allergic disturbances which affect the sinus mucosa
4. Frequency of contagious diseases

The subjective symptoms are usually less pronounced than in adults, particularly in the milder catarrhal forms. However, the constitutional symptoms, such as loss of appetite, fatigue, and gastrointestinal disturbances, are significant.

The objective findings that are helpful are unilateral discharge, nasal obstruction, and local tenderness. Transillumination is not satisfactory in children, but x-ray pictures can afford useful information.

Sinus puncture in children under the age of 6 years may be risky because of the close relationship to the orbit. In very young children the author recommends nasal suction after vasoconstriction. In chronic cases he advises antrostomy and shows a picture of a Thornwald perforator, curved rasp, and slender punch forceps.

Sanders [49] discusses the "problem nose" child, meaning the case with chronic nasal symptoms. The problem is complex because it involves an evaluation of the child's entire physical make-up as well as a determination of the local factors. Inherited tendencies, basic physical defects, allergy, and sinusitis all enter into the picture. It is important that all these factors be evaluated before the removal of tonsils and adenoids, since this operation cannot in itself effect a cure unless the contributing factors are properly dealt with. In this connection, the author admonishes against the routine administra-

tion of antihistaminics and antibiotics before a complete diagnosis has been made. A plea is made for more thorough instruction of medical students and interns in the field of rhinology.

Fernandez [50] presents an extensive discussion of ethmoiditis in infants and young children, pointing out the anatomic features which predispose to orbital and intracranial complications. He cites several cases of various degrees of severity. One case in an infant of 7 months progressed rapidly from an acute rhinitis to an acute bronchitis, acute mastoiditis, and death within six days due to a sinus thrombosis. The infection was resistant to variety of sulfonamides and antibiotics. On the basis of the clinical course of the case and the postmortem findings, the author concludes that the infection in the sinuses was transmitted to the lower respiratory tract by lymphatics and then by the hematogenous route to the mastoid, bypassing the middle ear. The diagnosis in infants is difficult unless there is early exteriorization, which frequently happens at the internal orbital angle. X-ray pictures are unsatisfactory at this age. Frequently the lesion is mistaken for dacrocystitis. The solution depends on thorough examination of the nasal passages with measures to facilitate drainage, such as vasoconstrictors, suction, and displacement and infraction of the middle turbinate. In two cases, after the usual antibiotics failed to influence the process, oxytetracycline was given with prompt resolution.

Fulminating cases with early symptoms of generalized infection and orbital symptoms require drastic measures in addition to anitbiotics and supportive treatment. External drainage is indicated.

In the subclincal or chronic cases, one has time to investigate the possible allergic factors which may be present and to bolster the child's resistance with appropriate general measures.

Wissler, Iselin, and Raber [51] state that chronic maxillary sinusitis is a frequent condition in children, being found in 50% of all patients with recurring infections of the respiratory tract, as reported by others. However, in their own experience it is present in only 1% of all children with clinically normal upper respiratory tracts.

Chronic cough is the most frequent symptom. Nasal catarrh is less frequent and headache is quite rare.

It is often associated with chronic bronchitis and is therefore no negligible disease.

The best diagnostic test is the x-ray of the sinus. In 80% of the cases the pictures were confirmed by diagnostic lavage.

Conservative treatment by regular irrigations, often combined with penicillin injections, resulted in complete recovery in about one-third of the authors' cases. If this fails, radical operation is indicated. The results were good in 14 out of 24 cases, satisfactory in 8 and unsatisfactory in 2.

Hampsey [52] finds that the diagnosis of allergy in children suspected of having sinusitis depends on the clinical examination and cytologic studies. The pallor of the mucosa so frequently associated with allergy may be absent if the child is examined during an acute upper respiratory episode. X-ray studies, in his experience, have been less reliable than in adults. In older children the instillation of radiopaque media has proved very helpful.

The author has found that intercurrent acute infectious diseases, such as measles and whooping cough, often disturb the allergic equilibrium of the child and precipitate severer manifestations of respiratory allergy. New sensitivities may develop in another organ. A previous mild allergy may show marked involvement of the sinuses and pharynx, with possible lower respiratory complications.

The most satisfactory cases are those with seasonal sensitivities due to inhalants. These respond satisfactorily to injections of high dilutions of the inhalant.

When food allergy is suspected, the author finds the individual food tests outlined by Rinkel more reliable than skin tests.

Wissler [53] says that the term "occult sinusitis" often used to describe the infection found accompany a chronic bronchitis in children is really not occult. Symptoms are present but not usually observed. The child, as a rule, swallows his nasal secretions, rarely blowing the nose.

Examination of these children will reveal streaks of mucus along the posterior wall of the pharynx and frequently some thick mucus and even some crusting in the nose. X-rays are invaluable, the half axial frontal projection offering the most information.

X-rays of the chest will reveal typical hilus shadows and peribronchial thickening. Lung mapping with contrast medium is necessary to determine whether or not bronchiectasis has developed.

Discussing the pathogenesis of this syndrome, the author attributes it in most cases to a combination of poor hygiene, inclement climate, congential disposition to respiratory infection, and inadequate diet. Frequent upper respiratory infections are the result, with the lower tract participating either simultaneously or as a result. Pneumonia and bronchiectasis may follow if the process is not halted.

Much can be done to help these children. The two most important therapeutic measures are proper cleansing of the sinuses and systematized evacuation of bronchial secretions. The author irrigates the sinuses twice weekly and administers penicillin for three weeks. If after two or three months the sinuses are not cured, he proceeds to do a radical antrostomy.

For the bronchitis he recommends breathing exercises, postural drainage and, at times, direct suction. General hygienic and dietetic measures must, of course, be strictly enforced.

Preston,[54] in an attempt to evaluate the relationship between tonsil and adenoid operations, frequent colds, and maxillary sinusitis, directed questionnaires to the parents of 52 children selected at random from the list of 1480 cases having previously had tonsillectomy and adenoidectomy. It was found that more of these children obtained relief if a concurrent sinus infection was treated at the time. Failure to recognize the antrum infection is often responsible for the poor results following some of these operations.

The author makes a plea for more thorough studies of the sinuses as well as of allergic tendencies in all cases where removal of the tonsils and adenoids is contemplated.

After a thorough analysis of the literature and on the basis of his own experience, Brown [55] finds that chronic sinusitis and upper respiratory infections are the commonest predisposing causes of recurring abdominal pains in children. Included are diseases secondary to sinusitis, such as mesenteric adenitis, appendicitis, rheumatic fever, Henoch's purpura, and "primary peritonitis."

The history in most of these cases will show that the attacks of pain are more frequent during the inclement seasons when upper respiratory infections are prevalent.

Diagnosis and therapy for the sinusitis are in line with present-day knowledge.

Raber [56] summarizes his conclusions on the subject of chronic maxillary sinusitis in children. He finds that the condition is commoner than is generally admitted. Every other child with a chronic cough is a sinus case. Most of these children are brought in to the ear, nose, and throat man because of their tonsils and adenoids. A truly symptomless sinusitis exists in only 1% of all cases. The cardinal symptoms are chronic recurrent cough and persistent continual colds. Constitutional symptoms are not prominent. Diagnosis is made through x-rays and explanatory irrigation. Therapy consists of repeated irrigations and large doses of penicillin.

Frindeisen [57] believes it important to examine the sinuses in every child having a chest x-ray. In 692 cases of bronchial asthma a sinus infection was present in 47.5%. He recommends injecting vasoconstrictors into the antrum in acute cases. In

chronic cases the adenoids are removed first, followed by administration of antibiotics and aerosol therapy. The author favors Schultz's technique for x-rays of the sinuses.

Mallet and Philip [58] offer a very brief review of the allergic manifestations in childhood. In infancy the conditions seen are cutaneous, gastrointestinal, and pulmonary. Later one finds asthmatic bronchitis in the picture and, still later, hay fever. All the well-known diagnostic procedures are mentioned and therapy outlined in the generally accepted formula.

Maspetiol, Chauvet, and Desbois,[59] while conceding that many cases of sinusitis in children are allergic, maintain that the majority represent a tissue hypersensitivity which is nonallergic. This is because they fail to find eosinophils either in the tissue or in the blood. They believe that the process is the result of a breakdown of the mucoprotein complex which results in the liberation of mucopolysaccharides. A single injection of 60 mg. of hydrocortisone into the antrum was tried in 19 cases. The immediate results were abatement of the clinical signs, shrinking of the mucosa as demonstrated by x-rays with iodized oil (Lipiodol) in 14 cases. In the other five cases no change was noted. When checked at the end of six to eight months, only seven cases could be reached. Four of these maintained the early satisfactory improvement. The others were only partially improved.

The authors found that oral administration of the hydrocortisone was less effective than local administration.

Vandam [60] recognizes four different clinical types of sinusitis in children: 1. Typical infection of the maxillary or frontal occurring between the ages of 7 and 12 and conforming to the picture seen in adults. 2. A transudative type running concurrently with bronchial troubles. It is a bilateral hyperplastic condition presenting nasal obstruction, turgescence of mucosa, edema, and clear nasal discharge. This type is predominantly allergic. 3. The "Mounier-Kuhn" syndrome, described as an inflammatory exudative rhinosinusitis, associated with chronic bronchitis, middle ear infection, and anomalies such as xyphoid deformity, dental abnormalities, and tracheobronchial conditions. 4. A condition in younger children (aged 3 to 5 years) in which the nasal symptoms are a part of a general constitutional deficiency.

The author thinks favorably of the Proetz displacement therapy in children, having employed it both for diagnosis and therapy. Also, he comments on x-ray therapy, which he credits to the English. Also he mentions vaccine therapy without comment as to personal experience.

Gordon [61] found that 71% in a series of 35 children with sinusitis showed eosinophils in the nasal smear. There were no symptoms of allergy in only 23% of the group. The symptoms ranged from recurrent respiratory infections (71%), cough (60%), nasal obstruction and discharge (54%), fever (51%), sore throat (34%), down to ear troubles (31%). The author is impressed with the value of the eosinophil determination in the nasal secretions.

Therapy followed out in these cases consisted of antibiotics for the infection, with precautions against drug sensitivity, measures to maintain ventilation and drainage, and antihistaminics.

The author finds that 0.5% cyclopentamine (Clopane) hydrochloride solution is the least harmful to children's noses and frequently combines with it, 2500 units of bacitracin to the ounce (30 ml.) cyclopentamine solution.

Surkin [62] finds that children under the age of 6 or 7 years seldom complain of symptoms referable to the nose. These young patients are usually brought in by the parents, who observe such things as nasal discharge and nasal obstruction. Beyond the age of 6 children do very often complain of headache and other symptoms of nasal disorder. The author examined 92 children in this category and found the x-rays a great help in pointing to sinus involvement. Puncture and lavage were em-

ployed without any ill effects, and cases yielding pus were treated by daily irrigation, followed by instillation of penicillin in saline, 150 to 200 units per cubic centimeter. The patient was immediately turned on the side with the irrigated sinus down for 30 minutes. If at the end of that time the fluid failed to appear in the nose, it was taken to indicate an advanced stage of mucosal involvement and the instillation of penicillin was immediately repeated. X-rays taken after a month of this therapy showed invariably a clearing of the cloudy sinus. The subjective symptoms and the discharge also abated. He even noted a decrease in the size of the adenoids in such cases.

Malignant Tumors

Verger[63] reviews the history of therapy in malignancies of the maxilla since 1925, discussing the various procedures, surgical, electrical, and irradiation, in vogue at different periods. The technique described by Hautaut and Monod at the Radium Institute of Paris is given in detail. The combination of surgery and radium is recommended for the relatively limited tumors. More extensive lesions do better with surgical diathermy and irradiation combined.

Beck[64] reports two cases of malignancy developing at the site of a previous injury to the face. In the first case the blow was severe enough to knock out a number of teeth and destroy the patient's denture. Two years later a neoplasm involving the superior maxilla proved to be a giant-cell sarcoma. Recurrences followed several extensive operations. In this case a contributing factor was brought out, namely, that the patient for years worked in a ceramic factory and had been exposed to the dust of plaster-of-Paris.

In the second case the man fell and struck his frontonasal area on a stone. Apparently there were no important findings at the time except nasal bleeding and bruising of the tissues. About six months later the patient began to complain of nasal obstruction which became increasingly troublesome, along with repeated nasal hemorrhages. Later the bridge of the nose became widened and the swelling extended to the lower orbital rims. The nasal passages were filled with tumor masses showing adenocarcinoma on biopsy. In this case the possible contributing factor was that the man consumed 100 gm. of pipe tobacco every week.

The author cites several previous communications dealing with the association of malignancy with previous trauma.

McMahon[65] reports this case of carcinoma of the antrum because of the patient's age (20 years) and the rapid progress of the disease to its fatal termination.

The symptoms had come on only four weeks prior to the first examination, with numbness of the face followed by swelling of the soft tissues, edema of the lids, and proptosis. It was assumed that the condition was an acute maxillary and ethmoid infection which was confirmed by surgery. However, tissue removed at the time revealed anaplastic squamous-cell carcinoma. Deep x-ray therapy was administered, 7800 r over 39 exposures. Despite local improvement a cervical mass appeared, which was also subjected to irradiation. This failed to halt the process, since generalized metastases appeared, leading to a fatal outcome within a few weeks.

This author calls attention to a fallacious assumption that carcinoma of the antrum metastasizes late. He cites Ringertz on this subject, who described the rich network of lymphatics stemming from the region of the ostium, running into the channels of the middle meatus and thence to the pharyngeal plexus and cervical nodes.

A case of malignancy of the upper jaw following trauma is reported by Niedermowe.[66] A 29-year-old woman was struck in the face by the handle of the baby buggy she was wheeling when it was struck by an automobile. The trauma inflicted necessitated removal of several fractured teeth from both jaws. The lower jaw healed promptly, but the upper one kept granulating until at the end of four months the

area was cleaned out, with examination of the tissue removed. The report was chronic inflammation with marked lymphatic infiltration. Two months later a swelling appeared in the alveolar area, the site of the injury. Biopsy now revealed a squamous-cell carcinoma. The patient was given an extensive course of irradiation, after which the maxilla was removed and, after healing had occurred, was replaced with a prosthesis.

According to the author, the history and course of this case leave no doubt as to the direct connection between the trauma and the development of the carcinoma.

Poulin [67] comments on the relative infrequency of early diagnosis in cases of carcinoma of the maxillary sinus. Diagnosis before bony involvement occurs is in most cases quite accidental. This emphasizes the importance of thorough study of all tissue removed from the sinus in routine surgical procedures. The author advises wide exposure in the surgical treatment, which is best accomplished through a large flap established by electrosurgery.

Irradiation should follow the surgery, and is best applied through the maxillary defect.

Becker and Matzker [68] discuss the symptomatology and diagnosis of carcinoma of the maxilla along the usual lines, emphasizing the value of correct x-ray examination in various planes and projections. They comment on the relative infrequency of metastic nodes (25%). They consider surgery the method of choice in dealing with these growths. If confined to the region of the floor of the sinus, they can be eradicated via the Denker approach. Otherwise, the external approach with resection of the entire maxilla is required. Postoperative irradiation with radioactive cobalt in a plastic prosthesis for as much as 8000r is advised. Neck resection is recommended in the presence of enlarged lymph nodes. Seventeen cases, all invading adjacent tissues, were seen in 1954. Four of these were considered inoperable and were referred for palliative therapy. Of the remainder, who were treated as outlined above, six were free of tumor signs and seven had died.

Raines and James [69] report their results in the management of 16 cases of carcinoma involving the maxilla. The entire bone is removed via a Mouri or Patterson incision, and the cavity is irradiated with gold seeds implanted into a mold that fills the operative defect. A tumor dose of about 7000 r was employed. The end-results are not given.

Hussavek and Kofler [70] operated on a 43-year-old woman for a carcinoma of the maxillary sinus which also involved the ethmoids. This was followed up by a course of irradiation therapy. The pathologic diagnosis was a predominantly solid, richly cellular growth of immature polymorphocellular tissue. About four months later both breasts were removed because of suspicious-appearing nodes. The histologic diagnosis here was the same. Within a short period metastases developed elsewhere and death ensued after a period of about four months. Autopsy revealed widespread carcinoma about the facial area previously operated on, and metastases in the spine, ribs and pancreas.

Gignoux and Gaillard [71] report three cases of carcinoma of the septum. They point out the greater danger of those which develop in the upper part of the septum as compared with lesions in the lower portion. One case, in a woman of 56, was of the former variety and was found to have involved the bony skeleton of the nose as well as the bony septum, with extension into the frontal and ethmoid sinuses. Despite surgery and irradiation, this patient died. The two other cases were in the lower septum and yielded satisfactorily to irradiation, remaining free from recurrence for eight and three years respectively. The dosage given was 7000 and 6000 r.

Franz and Porchia [72] state that remote bony metastases from epithelioma of the maxilla are very rare, having found only 38 recorded in the literature. The infrequency of this complication is attributed to the relatively poor vascularity of the

antrum mucosa and the greater tendency for the growth to invade adjacent structures and the regional lymphatics.

The case they report was in a woman of 56, wearing dentures for the past 12 years, who presented an ulcerated lesion in the upper fornix in the molar and retromolar area which, on biopsy, proved to be a squamous-cell carcinoma. She was treated by irradiation and later, when the nodes became involved, was subjected to a radical neck dissection. Pains in the dorsolumbar region led to the discovery of extensive bony involvement of the last four dorsal vertebrae. The patient died within two months.

Leduc et al.[73] had as a patient a man of 65 who complained of headaches for a year, increasing in severity in recent weeks. The sinuses were opaque on the one side, but irrigation of the antrum was negative. About two weeks later a swelling appeared over the right frontal area. The skin was reddened, and the mass was soft in the center but dense at the periphery. There was slight epiphora and diplopia. Considerable discharge was present in the nose. Because of the history of syphilis and a positive Wassermann test, the diagnosis of gumma was made. Penicillin and bismuth failed to affect the growth, which continued to expand. Biopsy revealed an extensive epithelioma which destroyed a considerable area of the frontal bone.

A case of chondrosarcoma of the nasal cavity in a woman of 40 reported by Soboroff and Lederer[74] was followed for a period of nine years. When the patient was first seen, the diagnosis was hyperplastic rhinitis. Two years later a mass was seen in the region of the middle turbinate, and there was clouding of the antrum and ethmoids. Biopsy was done and reported as chondrosarcoma. Surgery was refused at the time, but a year later an intranasal ethmoidectomy was performed. A year later the mass was found to have progressed, apparently involving the orbit. Radical surgery was advised but again declined. Two years later, when the growth had advanced to involve both sides of the nose as well as the ethmo-orbital region, a Ferguson approach disclosed involvement of the base of the brain and an inoperable status. Autopsy showed an extensive involvement of the pituitary fossa and apices of the petrous bones.

The authors advise prompt attention to cartilaginous growths which are prone to malignant degeneration.

Sischka[75] cites Herxheimer in describing fibroepithelioma of the nose and sinuses. It is a slow-growing mass in which the predominant changes occur in the epithelium, which increases in thickness, with squamous cells supplanting the cylindrical cells in many areas. The supporting fibrous elements may be either sparse or thick. Apparently this growth differs from true papilloma only in being less neoplastic in conformation.

Three cases are cited involving the posterior portion of the lateral nasal wall as well as the adjacent antrum cavity. In one case the histologic examination revealed a picture which was typical of adamantinoma.

These growths can be eradicated by excision and usually do not recur.

Rasmussen[76] reports a case of carcinoma of the ethmoid in a man of 49. There was a history of nasal polypi for several years, nasal obstruction, and bloody discharge. A fluctuating mass appeared later in the zygomatic region, and a bleeding growth was seen in the middle meatus. X-rays showed extensive destruction of the bony walls of the antrum. Biopsy was reported as showing "carcinoma planocellulare." Therapy consisted of preliminary ligation of the external carotid and x-ray therapy (4500 r). Six weeks later an Ohngren exenteration was performed, with removal of an extensive mass which was shot through with bony cysts. The resultant cavity, which was seared with the diathermy current, left a huge cavity, the floor of the orbit, a large portion of the zygoma and the lamina papyracea having been removed. Several gold radium needles totaling 20 mc.

were implanted. A detailed description of the histopathology is included.

A malignant tumor [77] of the maxillary sinus appeared to be a fibrosarcoma, according to the clinician who examined and later operated on the woman. However, the histologic diagnosis was epidermoid carcinoma. It had eroded through the posterior wall of the sinus and extended through the surface of the sphenoid.

A confusing item that was commented on was the greenish color of the mass, which suggested the possibility of a chloroma. However, the fact that such tumors arise from bone marrow, which is not present in the membranous facial bones, ruled out this possibility. Also the normal blood smear and white cell count would speak against it.

Huet and Villedrouin [78] report a case of meningoblastoma of the ethmoid in a woman of 25. The clinical symptoms and findings were moderate headache, exophthalmos without impairment of mobility or disturbance of vision, and a polypoid mass in the middle meatus. X-rays, including planigraphs, revealed opacity in the ethmo-orbital region with a dehiscence of the internal orbital plate. The mass seemed well defined, somewhat rounded, and cystic in appearance.

To avoid an external scar the area was exposed through a Denker approach, with removal of a portion of the frontal process of the maxilla. Biopsy showed masses of fusiform cells rich in calcospherites more or less matured. It was diagnosed as a meningoblastoma, which is the result of proliferation of meningoblasts, which, according to Oberling, are homologous to the cells of Schwann. The tumor was removed without entering the cranial cavity. The author believes it to have originated in the orbit and exteriorized into the ethmoid.

A tumor of the pituitary fossa presumed to be a chromophobe adenoma was diagnosed by Cade and Smith [79] on the basis of the symptoms of vomiting, salt and water depletion, low ketosteroid excretion, and lowered thyroid function. In addition, exophthalmos was present and x-rays showed complete destruction of the pituitary fossa with extension forward into the sphenoid. Surgery was refused by the patient, and he was treated by radiotherapy plus replacement with a testosterone implant of 400 mg. of cortisone and thyroid.

The first case reported by Beraud [80] was a plasmocytoma of the facial bones in a child of 6 years. It caused a bulging of the cheeks and jaws sufficient to interfere with mastication. The alveoli were thickened to such a degree as to reduce the palate to a narrow groove. Despite early favorable response to x-ray therapy, the tumor extended very rapidly to the nasopharynx and base of the skull and the patient died within the short period of 20 days.

The other case was a child of 2½ years, presenting a firm ecchymotic bulging mass over the forehead which developed very slowly and was at first thought to be a chloroma, but later was proved by biopsy studies to be a reticulosarcoma. It yielded satisfactorily to x-ray therapy, although a report of the condition beyond five months was not given.

The chondrosarcoma of the maxilla reported by Paterson [81] filled the sinus, extended into the orbit, destroying the floor almost back to the foramen and laterally into the inferotemporal region. An attempt was made to remove it through the hard palate, but its size and extent made it necessary to do a modified Ferguson operation. "The frontal process of the maxilla was divided from the pyriform opening into the orbit and the malar bone divided into what remained of the inferior orbital fissure."

The histologic examination showed a highly cellular mass with giant cells, nuclear pleomorphism, and occasional mitosis. It was considered to be a malignancy of low grade, apt to recur locally but less likely to metastasize.

Howarth [82] states that the greatest danger of plasmocytomas is their frequent association with multiple myelosis. These vascular

tumors, appearing red or purplish, arising in the bone marrow and submucosa, erode the surrounding tissues and grow at an irregular rate, being often mistaken for secondary carcinoma or remaining stationary for long periods of time. Bence-Jones proteinuria is considered the most important single sign of myelomatosis. Most of the cases originating in the upper respiratory tract are not associated with any bone marrow tumor. Still, in all these cases, great pains must be taken to examine the entire skeleton radiographically. Regional lymph nodes are reported to be enlarged in from 12% to 25% of all cases.

Division into benign and malignant forms depends on the history, rate of growth, and signs of generalized involvement. Simple excision of the former has yielded good results, although recurrences may occasionally be seen. The malignant cases require radiotherapy, surgery, and resection of regional nodes. Five cases are reported.

Cohn and Thoma[83] describe a case of plasmocytoma of the maxilla in a 73-year-old woman. Symptoms of pain and swelling interfering with the wearing of a denture developed in a period of several months. A soft bluish bulging mass was present in the anterior maxilla, extending into the palate. X-rays showed a loss of bone in the alveolus and palate. Biopsy revealed a plasmocytoma (slides are shown). It was treated by irradiation; 1900 r was delivered over a period of nine days. The tumor regressed completely, and a year later the patient was seen wearing a denture in comfort, with no sign of recurrence.

Ono and Yamada,[84] of Tokyo University Hospital, reported a case of multiple malignant growths simultaneously involving the uterus and right superior maxilla. This was proved by autopsy.

The patient was a 53-year-old woman. In November, 1951, panhysterectomy was performed for adenocarcinoma. On July 19, 1953, a Denker operation was performed on her right superior maxilla. After this last operation she became progressively weaker and died in March, 1954.

Histologic examination of the growth in the antrum proved it to be squamous-cell-carcinoma. The entire course of the disease lasted three and a half years. This is the first proved instance of multiple malignancy involving the superior maxilla to be recorded in the Japanese literature.

Takashi[85] reported his study on 78 cases of neoplasm originating in the maxillary sinus. Six of these had also invaded the ethmoid air cells. The object of this investigation was to observe the structure of tumors which developed in various areas of the paranasal sinuses.

The following types of tumor were included: adenoma, 1; papilloma, 3; carcinoma, 71; malignant melanoma, 1; reticulum-cell sarcoma, 2, and fibrosarcoma, 1. The author divided the origin of these tumor cells into (*a*) those originating from the epithelium and the greater part of the excretory duct; (*b*) those originating from the transitional part of the excretory duct and glands; (*c*) unclassifiable tumors. Those originating from the epithelium and the greater part of the excretory duct are (1) papilloma, changing to papillary carcinoma; (2) basal cells transforming into small spindle cells or small round cells, columnar cells, or squamous cell carcinoma; (3) typical clear cell or foamy cell carcinoma; (4) squamous cell carcinoma which seldom originates from the squamous metaplasia but takes its origin from basal cell or columnar cell. Cancer which originated from the transitional part of the excretory duct and associated glands may be classified into (1) adenoid cystic carcinoma cylindroma, solid or trabecular adenocarcinoma, mucous cell adenocarcinoma, and myxofibrous adenocarcinoma. (2) cylindroma which take their origin in the gland proper. Cancer which cannot be classified presents the picture of carcinoma simplex.

Nonmalignant Tumors

Certain features of the cases reported by Panikker[86] were of interest because of

the variance between the pre- and postoperative diagnosis.

In the first case a rather rapidly developing swelling of the cheek, with some pain and x-rays showing absorption of bone in the lateral wall of the antrum, was thought possibly to be a malignancy. At operation it was found to be a cyst of undetermined nature, containing no epithelium. The sinus ostium could not be found. The surgeons concluded that it was possibly a retention cyst.

In the second case a painful swelling of the cheek simulated an alveolar abscess. X-rays showed wide destruction of the bony wall, and operation revealed an epidermoid carcinoma. Irradiation was tried but failed.

The third case was in a woman of 54, who gave a history of trauma to the cheek five months previously. After the initial reaction subsided, she was free from symptoms for several months, when there was a rapid reappearance of swelling and pain, with slight proptosis and facial asymmetry. X-rays revealed complete destruction of the zygoma, extending into the maxilla and involving the lateral wall of the sinus and floor of the orbit. Operation disclosed an extensive squamous cell carcinoma.

Vyslonzil[87] describes a case of meningioma in a woman of 50, which developed within the frontal bone causing severe headaches and presenting as a smooth hard mass in the midline of the frontal bone. When removed, it was found well encapsulated beneath the thin anterior cortex.

Histologically the mass consisted of a mesenchymal tissue of the psammous type associated with meningiomas. Here and there irregular pieces of bone were found. These were centrally calcified and surrounded by uncalcified areas. The bone surrounding the tumor was composed of compact lamellar bone with relatively small marrow spaces. The sinuses were apparently not involved.

Speculating on the pathogenesis of this growth, the author assumes that it arose from the second germ-layer and would have to develop between the second and third fetal month, because it is at this period that the brain covering is differentiated and the tumor germ finds itself in the frontal bone anlage as well as the embryonal fontanelle. Closure of the interfrontal suture about the end of the second year would seal off the mass within the bone.

According to Martensson,[88] cysts of the antrum may cause erosion of the bony walls simulating a malignant growth. Two cases of this type are reported. On the other hand, a carcinoma may develop within an apparently benign cyst without any evidence of bony involvement and would be discovered only on histologic examination. Two cases are reported. The author stresses the importance of routine histologic studies of all cysts removed from this area.

Murphy[89] reports a case of osteoma in a man aged 28, which displaced the bulb laterally 2 cm. and downward 1 cm. At operation, a mucocele was found in association with the osteoma which almost completely filled the frontal sinus. This mass extended under the orbital rim and connected with a mass in the orbit. There was no postoperative diplopia.

Two cases of osteoma of the ethmoid cells are described by Pykosz,[90] both in women, aged 37 and 44. The former was removed endonasally; its size was $4\times2\times2$ cm., and weight 20 gm. The other was removed via a Denker approach and was larger, measuring $8\times4.5\times3.5$ cm. and weighing 48.5 gm.

Goedel[91] shows pictures of a beautifully outlined small encapsulated osteoma in the frontal sinus. This was easily removed via a Riedel operation. However, within two or three weeks the patient developed severe neuralgia in the orbital area, plus diplopia. Relief from the former was temporarily afforded by injections of procaine hydrochloride. The diplopia was particularly distressing because the patient required accurate focusing in his work.

The author states that the condition may be corrected by Oxhausen's operation, in which the bulb is shifted and supported by

a cartilage implant. However, he himself would prefer using muscle or fascia.

In the first of two cases of osteoma reported by Som and Khilnani [92] the mass was clearly defined with its narrow pedicle and was observed for two years, during which time it increased to almost double its previous size. It was removed through the floor of the sinus without disturbing the anterior wall.

In the second case (a boy aged 15) the mass was unusually large and in the x-ray pictures it appeared to occupy both frontal sinuses. It seemed to increase in size over a period of six months, causing a bulging of both anterior and posterior walls of the sinuses. At operation the tumor was found to have eroded the frontal process of the left maxilla, lacrimal bone, and lamina papryacea and had thinned out the left nasal bone and nasal process of the frontal bone. Its attachment was found in the ethmoid region, and after removal it was noted that it had eroded the posterior wall of the frontal sinuses, exposing two areas of the dura. The growth measured $6 \times 5 \times 4$ cm.

Tosch [93] summarizes the statistics of several authors on the incidence of osteomas in the sinuses. Of 532 cases thus catalogued, there were 27 involving the maxillary sinus. There have been no reports of bilateral osteomas of the antrum until the case cited by the author, which forms the basis of his presentation.

The patient was a 48-year-old man with a history of a mastoid operation at the age of 7, which left him with facial paralysis. For the past several years he had noticed a slowly increasing protrusion of one eye and some nasal obstruction. Examination showed one eye proptosed and displaced laterally but no impairment of mobility. There were several polypi in both middle meati, and the septum was deviated. X-rays disclosed clouding of both antrums. At operation one antrum was found almost completely filled with a bony mass. The opposite antrum was not opened. However, the ethmoids were exenterated. Two years later polypi had recurred on this side and were again removed. The antrum from which the osteoma had been removed was no longer accessible for probing. Also, x-rays revealed a recurrence of the bony mass. The fact that the septum had also been thickened in its bony portion suggests the possibility of a generalized osteoma formation or a systemic malady of the Paget's type. However, the author insists that these were definitely excluded.

Perint [94] reports three cases of osteofibroma of the maxillary sinus. In one case it was situated near the roof of the sinus. In the other two it was in apposition to the alveolar process and in both of these gave rise to symptoms referable to the teeth.

Skolnik and Fornatto [95] report four cases of ossifying fibroma involving the sinuses. The patients ranged in age from 7 to 28 years. Early symptoms were few, the diagnosis not being arrived at until external swelling brought the patients to the clinic. A cure was effected through wide excision of the mass. Histologically the tumors were pronounced benign. Evidence of progression was noted by the presence of areas of osteoid tissue and islands of bone trabeculae. In two of the cases there were areas showing cystic degeneration.

Commenting on the nomenclature, the authors call attention to the relationship between ossifying fibroma and monostatic fibrous dysplasia. It is generally agreed that the former is a variant of the latter. Much of the confusion in the naming of these growths is due to the varying amounts of fibrous and osseous tissue as reported by various authors. The more mature types are definitely more osseous and are seen in older persons.

Missura and Galle [96] present a rare case of osteoclastoma of the frontal sinus, describing the histologic structure and a surgical procedure in which a hinged flap of temporal muscle was used to obliterate the cavity.

Douniau [97] reports three cases of localized osseous dystrophy, one involving the mandi-

ble in a woman of 39, the second the superior maxilla in a boy of 17, and the third the frontal bone in a girl of 19. The characteristics of this process are listed as follows:

1. The fibrous monostatic osteopathies are strictly localized
2. Limited symptomatology, indicated by general well-being, absence of functional disorders, absence of endocrine and metabolic disturbances and presence of only minor blood changes
3. Previous history noncontributory
4. Negative biochemical findings
5. Extremely slow development, with proliferative activity more marked in the young but without malignant or degenerative tendency
6. Histopathologic changes of osteopathic fibrosis of the Paget type
7. Conservative surgery with removal of irritant foci (if such are present) and correction of the hematologic irregularities usually successful
8. Etiology and pathogenesis undetermined

Irritative foci such as periodontic infection are believed to be of etiologic significance in growths involving the jaws.

Atav[98] cites a case of neurofibroma of the ethmosphenoid in a man of 64. Aside from nasal obstruction there were no subjective symptoms. Externally the mass produced a swelling along the side of the nose and below the orbit, which was smooth, pale red in color, and of moderately dense consistency. It was removed via a lateral rhinotomy. Histologic examination revealed Schwann cells in bouquet-like clusters with uniformly staining nuclei.

Kanthak, et al.[99] present eight cases of fibrous dysplasia of the facial bones, the etiology of which is still not clear. Opinion is divided between Lichtenstein and Jaffe's contention that it is an abnormality of the bone-forming mesenchyme and the assumption that it is a true neoplasm. In some cases it is difficult to differentiate it from an ossifying fibroma or a fibrous osteoma. The history in most cases is of gradually developing asymmetry of the face due to enlargement of one or more of the bones. Occasionally there is a definite history of trauma. The maxilla is more frequently involved than the mandible, although the two may be affected at the same time. X-rays reveal a radiopaque area often showing clear areas that look like cystic cavities but are due to different densities of bone and fibrous tissue.

Therapy should be directed to removing the excessive areas of growth which in most cases can be accomplished by intraoral rather than external incisions. X-ray therapy may be useful to reduce the size of the mass or retard its further development. Several cases are shown in which the entire antrum area was solidly opaque.

In Laage's case of eosinophilic granuloma[100] the early diagnosis tended toward osteomyelitis. It concerned an 18-year-old boy who developed a tender swelling above the eye in a period of seven weeks. The mass increased gradually, causing headaches and lacrimation. There was no history of trauma. X-rays showed an area of bone absorption about 0.5 cm. in diameter. Mucocele was ruled out because the mass was not in relationship to any of the sinuses. Operation disclosed a large bony defect just above the orbital rim; the surrounding bone was very vascular. The frontal sinus was opened, and the mucosa was found to be thickened. The mass had invaded the orbit, destroying part of the periorbita, and was adherent to the dura. Frozen sections showed eosinophilic granuloma. The mass was separated from the dura, and the surrounding bone, which was very soft, was removed, leaving a large defect down to the optic canal. The cavity was obliterated as in the Riedel operation.

Blood cholesterol and findings on sternal puncture and lumbar puncture were all normal.

Offret et al.[101] report a case of eosinophilic granuloma in a child of two. It presented a smooth, slightly elastic growth at the external border of the orbit with considerable edema of the lid and temporal fossa area. Biopsy revealed subacute inflammation of connective tissue which was infiltrated with plasma cells, mononuclears, and giant cells resembling plasmocytes with eccentric nuclei, a few with double nuclei,

and acidophilic protoplasm. X-rays showed a loss of bone of the external orbital margin extending down into the malar bone. At operation a defect measuring 1 cm. was found. The mass itself consisted of soft homogeneous material. The cavity was curetted and the dura exposed; it was normal. Healing was uneventful. Histologic studies showed eosinophils of the macrophage type, giant plasmocytes with eosinophilic protoplasm, eosinophils containing two or three nuclei, and plasmodes with several nuclei.

The authors state that x-ray treatment is ineffective and no better than simply leaving the lesion alone.

Crudelli and Tartarini [102] report a case of myxoma which developed in the base of the middle fossa, eroding into the sella and the sphenoid sinus, causing blindness in one eye with displacement of the bulb. The process was noted over a period of six years with periods of activity and remissions. X-ray pictures and angiograms revealed the approximate location and extent of the mass, which was successfully removed. Histologically the sections showed stellate or fusiform cells, average 6.5β imbedded in a transparent collagenous mass with fine fibrils coursing in all directions. The tumor was of mesenchymal origin and was found to contain a high percentage of hyaluronic acid.

Centeno [103] reports a case of giant-cell epulis extending from the central incisor to the second premolar, with a wide base of attachment between the cuspid and the lateral incisor. The two teeth had to be removed, and the denuded area remaining after excision of the mass was covered with a buccal mucoperiosteal flap. Photomicrographs show nests of giant cells.

Zarabi [104] presents a case in which a mucocele of the frontal sinus had broken into the orbit, forming a well-defined mass which was taken to be a tumor, possibly malignant. There was a history of recurring crises of severe frontal pain over a period of 30 years. The mass was located in the superointernal portion of the orbit, causing displacement of the bulb and a diplopia.

Wild and Klotz [105] divide mucoceles of the anterior ethmoid into two groups, viz., the localized, which are confined to the middle meatus cells, the uncinate or the agger group, and the generalized, which involve the entire ethmoid labyrinth. Two cases are reported. Emphasis is laid on the value of good x-ray pictures for diagnosis and localization, particularly the planigraphs, which, however, are not too clearly reproduced in the publication.

Treatment depends on the size of the accumulation and the direction of its growth, whether toward the nasal cavity or into the orbit. The endonasal approach may be adequate in the former, whereas in most cases of orbital extension the external route is more feasible.

Caliceti [106] presents 10 cases of mucocele and a lengthy review of the entire subject. Only one of the cases cited had a clear history of previous trauma. Several of the others gave a history of recurring upper respiratory infections, influenza, etc. One case was discovered after an attack of erysipelas. A discussion of the various theories of the etiology fails to yield a simple answer. The author sums up his experience as follows:

Mucocele is more frequent in young adult life, divided equally between the sexes.

The pathology is not uniform except insofar as the presence of obstruction to the normal ostium is concerned, which may be due to trauma, inflammation, abnormal anatomic features, or neoplasms.

The cavity itself is lined with secreting mucosa with irregularly infiltrating perivascular stroma. There is no such thing as a definite capsule.

Complications are the result of pressure absorption of the bony walls of the sinus with protrusion of the mass into the orbit or cranial cavity.

Most cases must be exenterated via an external operation, although in a few in-

stances the mucocele can be widely uncapped intranasally.

Mucoceles of the sphenoid sinus are uncommon and frequently mistaken for pituitary tumor. In one case reported by Simon and Tingwald [107] progressive loss of vision leading to optic atrophy was at first attributed to a pituitary adenoma. There was a history of headaches and nasal obstruction, with an operation having been performed for a growth which was only partially removed, releasing some dark fluid. Since then there had been some occasional nasal discharge and episodes of swelling and protrusion of the eye. The left ethmoid and sphenoid were opened with access to a large cystic cavity. When seen several years later, the cavity was still open, the nasal symptoms had subsided, but the blindness still persisted. Iodized oil (Lipiodol) in gauze packed into the cavity revealed erosion into the floor of the sella.

In the second case with similar symptoms the x-rays showed erosion of the floor of the sella, and again a diagnosis of pituitary tumor was made. A craniotomy demonstrated the presence of a mucocele, which was decompressed. However, the symptoms recurred, and several weeks later the mucocele was drained intranasally. This failed to cure the patient, and about six months later the cavity was exenterated via an external ethmoid approach.

The authors describe the syndrome associated with these tumors as the "orbital inlet syndrome" with headaches and disturbances of vision. They discuss the radiologic features in diagnosis and the differential diagnosis from meningocele, meningioma, encephalocele, and optic nerve tumors.

A case of frontal sinus mucocele is reported by Cenci.[108] A 27-year-old man sustained an open fracture of the frontal bone in a boiler explosion. Apparently there were no after-effects until he reached the age of 57, at which time he began having recurring attacks of upper respiratory infection. About two years later an orange-sized mass appeared in the region of the frontal process. On examination the middle turbinate presented a polypoid appearance and x-rays revealed a circumscribed mass in the frontal sinus. When explored, a cyst-like cavity containing a brownish purulent material was found along with osteofibrotic bands of tissue. The sinus appeared to be divided in half by these fibrotic bands.

Atkinson [109] had an interesting case of an enormous bilateral frontal mucocele in a man of 56. This patient was acromegalic as well as diabetic. After an attack of nausea and vomiting he was admitted to the hospital, where an examination disclosed ptosis and impaired sensation in the face. The x-rays revealed an enormously expanded mucocele extending backward and downward, causing displacement of the anterior horns, the anterior cerebral artery (shown in the angiogram), and erosion of the sella. It was removed via a bifrontal craniotomy. There was a defect over the cribriform plate which had to be covered with fascia and tantalum mesh. The resultant cavity in the anterior cranial fossa continued to fill up with fluid and drained into the nasal cavity. After three weeks of daily aspirations the discharge ceased. The symptoms arising from pressure on the trigeminal and oculomotor nerves disappeared within one month.

Faria,[110] reporting a case of mucopyocele of the ethmofrontal area, the only one encountered among 10,000 ENT patients, takes occasion to review the entire subject of mucoceles. He compares them to paradental cysts, claiming that similarly they develop from embryonic epithelial rests. Their growth is the result of intercurrent infection or trauma. He presents a fairly complete bibliography on the subject.

Gardenghii and Michell-Pollegrini [111] describe two cases of pseudocyst of the frontal bone, both containing cholesterol crystals. In one case there were no subjective symptoms, the patient seeking advice because of a displacement of the bulb which was caused by a smooth dense mass at the superointernal angle of the orbit. When

the mass was opened through a supraorbital incision it was found to contain a brownish liquid with numerous bright particles of cholesterol. It was separated from the frontal sinus by a membranous septum which moved to and fro during the respiratory cycle. It consisted of several layers of connective tissue covered with ciliated epithelium on the sinus side and fibrous tissue on the tumor side, which contained numerous small vessels with paravascular infiltration and areas of fatty degeneration.

The second case was similar and, in addition, revealed a cleft in the wall of the cyst which was lined with stratified columnar epithelium.

On the basis of the histologic findings, the authors were inclined to conclude that the pseudocyst developed in the wall of a true primitive cyst.

Linke[112] relates the history of a man aged 62, who had a marked inner ear deafness, first in one ear and then the other, accompanied by vertigo at the beginning, which later subsided. He failed to respond to various types of therapy such as vitamins, sweat baths, and stellate ganglion block.

Eventually he was found to have a cyst in one antrum, whose removal was immediately followed by return of hearing. An interesting observation in this case was the recurrence of the deafness the day after surgery, when the antrum filled with blood. Removal of the blood was rewarded by the immediate improvement in hearing. The author explains this phenomenon on the basis of a disturbance of vegetative nervous system in a sensitive field, which reacted by the production of labyrinthine dystonia.

A case of an epidermal inclusion cystic tumor of the frontal bone communicating with the frontal sinus in a man of 34 is reported by Caparosa.[113] It appeared to have developed about six years after a simple trephine operation on the sinus. During this period the patient had repeated attacks of headache and foul discharge from the nose. A swelling appeared over the frontal area, and x-rays revealed a cystic area above the sinus. An external frontoethmoidectomy failed to cure the patient, even though the area was thoroughly curetted and a broad communication established through the sinus. A radical craniotomy was then done which permitted complete excision of the entire bony walled cavity. The patient has been symptom-free for 18 months.

The case reported by Pizer[114] was in a woman of 19 who had a tender swollen area in the region of the third upper molar. X-rays showed a radiopaque body high up in the posterior wall of the sinus (about 5×9 mm.) surrounded by a thin cystic wall. A right-angled incision in the buccal recess afforded access into the sinus just above the first and second molars. The dental element was found imbedded in the posterior wall of the sinus, surrounded by a cystic wall, all of which was removed. Histologically the tissue was dense and fibrous and relatively acellular. The lining was a fibrous connective tissue with a few strands of squamous epithelium.

Surgery

McNaught[115] reviews the progress in sinus surgery over the past 30 years, due to a better understanding of nasal physiology and increasing interest in the role of allergy. The trend toward conservatism has resulted in fewer so-called radical procedures and emphasis on the preservation of infected mucosa because of its remarkable tendency to recover, once proper facilities for drainage have been afforded. The Caldwell-Luc procedure has given way to intranasal antrostomy, which affords an accessory opening into the sinus, thus permitting the normal ostium to regain its normal status.

McNaught points out the necessity for having a definite objective when planning a sinus operation. Three such objectives are discussed, namely, preservation of a well-drained dead space, obliteration of the sinus by solid fibrous tissue, and ablation by removal of supporting bony walls to

permit collapse of the remainder. These are all discussed with reference to each of the sinuses in particular. The author devotes some space to the frontal sinus, pointing out the various maneuvers involving the use of mucous membrane flaps for proper lining of the newly formed passage into the nasal cavity.

Of vital importance in all cases, except where a sinus is to be obliterated, is the necessity for preserving the normal ostium.

Statistics relating to the results in the treatment of carcinoma of the sinuses from the Memorial Hospital over a period of 12 years as reported by Frazell [116] show 22.5% of five-year cures. They were treated mostly by a combination of surgery and irradiation, with emphasis on the former in the more recent years. Wide excision via the Weber-Fergusson approach, sacrificing the eye in every case where the lesion has involved the floor of the orbit, is favored. The cavity is immediately lined with a split graft held in place by packing for 8 to 10 days. Complications have been rare under the judicious employment of antibiotics.

Irradiation alone has yielded a smaller percentage of recoveries and is reserved for postoperative treatment in some cases.

Hargrove [117] describes the procedure he follows in dealing with recurring polyposis of the ethmoids. X-ray films of the sinuses are not always helpful but may at times show varying degrees of osteoporosis or sclerosing osteitis. Polypi are removed without disturbing the turbinate or entering the cells, and the patient is observed after a few weeks. In the meantime allergic studies may be undertaken. If the polypi recur, it may be necessary to undertake an exenteration, and for this the author prefers the Norman Patterson operation, details of which are well illustrated. In this procedure "the entire ethmoid labyrinth is removed together with the medial third of the floor of the orbit, the lacrimal bone and a portion of the frontal process of the maxilla lying anterior to the nasolacrimal duct. Care must be taken in removing the posterior third of the lamina papyracea owing to the close proximity of the optic foramen which is lying in the lesser wing of the sphenoid."

Seventy cases operated on by this technique have been reexamined at intervals of six months for two years and then at yearly intervals. In a few cases some remaining tags had to be removed. In only one case was there a recurrence of any consequence, due to a highly allergic state.

Taylor [118] presents the anatomical landmarks of the orbit which are within the field of operation, pointing out the structures which must be avoided in this technique. Ocular complications which may occur are disturbance of tear drainage due to injury to Horner's muscle, the lacrimal sac, or the canaliculi, loss of visual acuity due to direct pressure on the eye or injury to the optic nerve, disturbance of muscle balance due to interference with the origin of the inferior oblique or the check ligament of the median rectus.

Harrison [119] states that the Norman Patterson operation is a modification of the accepted external ethmoidectomy which affords a wider exposure of the ethmoid labyrinth and enables one to expose the antrum at the same time. "The transantral approach to the ethmoids gives a less adequate exposure of the sphenoidal sinuses than Patterson's, which also gives after a small extension of the excision a good exposure of the floor of the frontal sinus."

The indications for the operation are frequent recurrence of polypi, especially if there is x-ray evidence of sinus pathology; recurring polyposis with expansion of the nasal bridge; history of previous ethmoid surgery of unknown extent; caries of the orbital plate; cases where the frontal sinus requires investigation.

Records of the clinic showed that half of the 551 cases of polyposis were associated with infection in the sinuses.

The author emphasizes the importance of hemostasis during the operation. The addition of a wetting or spreading agent to

the local solutions has proved of value. The initial incision should go only through the skin, exposing the deep fascia where the vessels can be identified and ligated before the orbicularis is penetrated.

The author advises great care in the handling of the tissues to avoid traumatizing them, avoiding the use of retractors. Exposure of the deeper areas can be had by using mosquito forceps or the Killian speculum for a time.

The discussion that followed was opened by Prof. V. F. Lambert, who expressed his appreciation for the opportunity afforded him by the late Mr. Patterson of witnessing his operation on two patients. However, he regretted his inability to duplicate Patterson's good results in his own cases. He believed that the operation, like all ethmoid procedures, may fail because of unsuccessful clearing-out of the anterior group of cells lying in the frontal process.

Mr. V. E. Negus considered polyposis as more of a generalized than a local condition and stressed the importance of medical therapy. In most cases endonasal removal of the presenting polypi is adequate. Surgery is indicated if infection is present, and the type of operation to be employed depends on the extent of the process. He favors the curved incision from below the brow, curving around the inner margin of the orbit, well away from the canthus. He finds the infraorbital incision inconvenient, which makes the elevation of the orbital periosteum and lacrimal sac more difficult than by the other approach.

Mr. Ogilvy Reid was converted to the Patterson operation after watching Mr. Hargrove demonstrate it. He has found it convenient to deal with the antrum via this approach.

Mr. F. C. W. Capps would limit the Patterson operation to cases of suppurative ethmoiditis which is usually associated with a maxillary sinusitis. Nevertheless, the transantral approach via a Caldwell-Luc incision is just as acceptable with the one exception, namely, that it does not afford as good a view of the most anterior ethmoid cells as can be obtained with Patterson's technique. However, he pointed out that the danger of osteitis or osteomyelitis in this procedure is greater than in the Caldwell-Luc operation.

Mr. Leslie Thomas suggested that in addition to the Patterson approach one may employ a Caldwell-Luc incision and could deal with pathology in the anteromedial angle or the antrum. The combination of the two techniques affords visualization from three angles, namely, above, below, and medially through the naris.

Mr. J. B. Thorburn finds the transantral Caldwell-Luc procedure adequate in most cases. The inaccessible anterior cells can be reached readily by the ordinary intranasal approach.

Mr. Hargrove, replying to Mr. Negus, stated he had found no difficulty in removing the frontoethmoidal cells and making a complete removal of the polypoid ethmoid labyrinth. So far as the frontal sinus is concerned, he rarely found it necessary to disturb it, since adequate drainage provided by the ethmoid exenteration facilitates the drainage and ventilation of the frontal.

Mr. Harrison concluded by stating that the agger nasi cells could be adequately exposed in the Patterson operation. Frontal sinusitis was not a common complication in his experience. Failures occur in this procedure as in all other ethmoid operations because it is not always possible in every case to remove all of the cells.

Though frequently confronted with the problem of nasal polyps, few rhinologists have given thought to more than the clinical aspects. Clerici et al.[120] studied the pathogenesis, histopathology, and histochemistry in addition to the clinical aspects of 50 cases of naso polyps. They believe that the etiopathogenesis of these new growths may be ascribed to four different factors: the anatomic structure of the rhinosinusal mucous membrane, the vasomotility of this mucous membrane, a constitutional condition of the extra-allergic hyperergy, and an attenuated chronic inflammation. According to the authors, none of these factors

could, by itself, explain the genesis of polyps, but all of them cooperate in their formation. "From the histological point of view, the following findings appear to be of some interest: the presence of a great number of lacunae full of an edematous liquid, containing small quantities of proteins and mucopolysaccharides, the presence sometimes of an aspecific infiltration around the vessels, as has been described for dysergic-hyperergic conditions, the existence of 'Mastzellen' which may be held responsible for the great amount of precollagenous fibrils, being the last of the histological characters of these polyps."

Kehrmann[121] describes an ingenious method of preventing displacement of the bulb following extensive surgery of the upper jaw in malignancies. This is bound to occur when the floor of the orbit and parts of the malar bone are removed. Holes are bored through the stump of the malar bone or zygoma and through the frontal process of the superior maxilla on a level with the floor of the orbit. A wire of about 0.4 mm. thickness is threaded through the holes and protected by rubber tubing and is tightened, thus forming a supporting bridge across the line representing the floor of the orbit. In some cases a flat piece of rubber may be attached to the wires to afford additional support. If the frontal process has been removed the wire can be carried through the bony septum and in some cases even through the frontal process of the opposite side.

This contrivance is left in place for four weeks, by which time a fibrous bridge has grown across the area which is sufficient to prevent displacement of the eye.

In the 13 cases thus treated the position and function of the eye remained unimpaired.

On the basis of the paper of Prietzel two cases of endonasal trepanation without curettage performed in two cases of maxillary sinusitis are presented by Mileusnic.[122] The author suggests this method, comparing it with the older ones, as a very easy and satisfactory procedure. The postoperative period is usually an easy one and passes without complications. The hospital stay is considerably shortened.

Rohrt[123] has found it practical to use an indwelling plastic tube for drainage and irrigation in cases of chronic maxillary sinusitis. It is introduced through a large-bore cannula forced into the sinus via the inferior meatus and is left in place for several days. It is particularly useful in treating children, since it avoids the inconvenience and distress of repeated punctures. Besides, it is convenient for instilling pharmaceuticals following irrigation.

Keresztesi[124] claims that the majority of alveolar fistulae following extraction of teeth can be closed by conservative methods. He advises freshening and undermining the margins of the alveolar mucosa and approximating them as close as possible without tension and tying the sutures over a plug of Mastisol-impregnated iodoform gauze which seals the incompletely closed opening. This is left in place for 8 to 10 days, during which time heat therapy is applied. If a small aperture is still present after removing the plug, he advises cauterizing the tract and continued use of the heat therapy.

Cases already complicated by antrum infection and cases failing to yield to conservative therapy must be operated upon.

In a series of 16 cases treated as described above, the author obtained a closure of the fistula in 14.

Zange[125] describes a technique for closing an alveolar antrum fistula which is applicable only in cases when a Caldwell-Luc operation is done to clean out an infected antrum due to perforation of its floor in the removal of a tooth. This obviates the necessity for a secondary operation to close the fistula, as is usually the case. The technique consists in the liberation of the nasoantral wall of the inferior meatus and turning it down over the alveolar recess. It is necessary, of course, to have a large flap, which means from the attachment of

the inferior turbinate to the floor and as far anterior and posterior as possible. The flap is secured by two catgut sutures to the margin of the gums and held down by a pack which is removed within two to four days.

The author claims to have performed this operation successfully in seven cases.

Mundnich [126] shows a model prosthesis to replace a totally excised superior maxilla. The material is not specified, but it looks like acrylic. It consists of a section modelled to fit the cavity of the cheek, which is hinged onto a palatal extension, and is hollow, containing a block on a spring which facilitates locking and unlocking the device for insertion or removal.

Sargenti [127] repaired an oroantral fistula of two years' standing by excising the epithelized tract as well as a quadra-lateral area surrounding the opening, and covering it with a hinged flap derived from the loose tissues in the alveolar-buccal sulcus.

A survey of 153 consecutive unselected cases of oroantral fistula provides the material for a study of this problem by Reading et al.[128] The anatomic variations are described, and the pathology resulting from the production of the communication is thoroughly analyzed. Emphasis is laid on the part played by the dental surgeon in attempts to recover broken roots and periapical abscess as etiological factors. The immediate treatment is based on general principles of traumatic surgery, namely, removal of dead tissue or foreign bodies, preservation of all vital tissue, approximation of wound edges without tension, splinting against further damage and control of subsequent infection. Most of the early uncomplicated fistulae will heal spontaneously or with simple suture.

It is not advisable for the dental surgeon to look for a misplaced root fragment by enlarging the opening. If the x-rays reveal the foreign body within the antrum it can be removed only through the canine approach. This is particularly important if infection is already present.

The authors, however, point out the sequelae of the Caldwell-Luc particularly the persisting numbness of the teeth and gums, and suggest that wherever possible the antrum be treated via the intranasal antrostomy.

Carruthers [129] suggests a method of preventing indwelling polyethylene tubes introduced into the antrum from falling out. The tubes which are long enough to encircle the alar border and extend up the length of the nose are fastened to the columella by a Michael clip through which the tubes have been threaded. The teeth of the clip need not be gripped too tightly into the tissues. Photographs show the tubes thus secured and fastened to the nose and forehead by adhesive.

Hargrove [130] describes with illustrations a procedure for closing a chronic oroantral fistula. Essentially it consists of two flaps, palatal and buccal, united over the opening, which has been enlarged so as to elevate the united oral mucosa to the level of the antral mucosa both lingually and buccally. A quick-setting impression is then taken and a plate prepared which is cemented to the remaining teeth and worn for seven days, when the sutures are removed. A second plate, previously prepared, is worn without being cemented to the teeth, to keep pressure on the flap, and is used until the permanent denture is fitted. Several cases are reported.

Cartledge [131] gives the details for the design, construction, and retention of appliances to be used at the conclusion of an operation closing an oroantral fistula and its subsequent protection. He refers to the technique described by Hargrove, which envisions raising the level of the palatal flap and shifting it so that the suture line falls in the buccal sulcus rather than over the crest of the alveolus.

The technique of constructing the retaining denture embodies several progressive steps: An initial preoperative alginate impression is cast in stone. The model is covered with layers of tinfoil and acrylic

plates (clear for visibility of the underlying mucosa) are worked up. The plate has a recess corresponding to the palatal flap area, which is filled with zinc-oxide-eugenol paste at the conclusion of the operation. This is then cemented to the remaining teeth. A duplicate plate is sent to the laboratory, where the acrylic resin is substituted for the paste and used in place of the temporary one. The permanent denture is made from impressions taken after the sutures are removed.

The article is well illustrated.

Lewkowitz [132] submits a modification of the Hinsberg operation for ozena, in which the nasoantral walls are shifted medially and held by wires passed through and through from one antrum to the other. These wires go through the inferior turbinates and the septum.

Lewkowitz avoids these foreign bodies by using a clip which is introduced into the antrum after the medial walls have been chiseled free and infracted medially. The two blades of the clip, which somewhat resembles a Killian speculum, are held together just over the frenulum by a slip spur and are left in situ for about 10 days.

This procedure was successful in 70% of the 223 cases so treated. It is amazing that ozena, which is comparatively rare in the United States, should be so common in the Middle East.

Brown and Goodhill [133] recommend trephining the floor of the frontal sinus in cases of acute fulminating infection frequently due to swimming. Because of the danger of rapidly spreading complications, it is imperative that, along with the administration of antibiotics, the sinus be opened for drainage. The thin compact bone of the sinus floor should be perforated with either a hand drill or a dental-motor-driven trephine, and the opening made large enough to admit an 8 mm. polyethylene tube. No manipulation should be done within the sinus. After this procedure the patient should be carefully watched for signs of possible extension to the floor, the anterior or posterior walls, and the orbit.

Schmidt [134] credits Hajek with being the first to advocate trephining the frontal sinus in acute conditions as a prophylactic against complications. The author advises this procedure, which he carries out through the floor of the sinus near the internal angle of the orbit, not only in acute conditions but in certain chronic conditions. He cites two of a series of nine cases of chronic frontal sinusitis which have remained symptom-free for two years. These were cases of suppuration with edematous mucosa and polypi. He considers it worth while since in many cases it will save the patient undergoing a radical operation, which in many cases is not completely successful. The cases he cited were treated by irrigation through the aperture with saline and antibiotics.

Fiebach [135] recommends puncture and irrigation of the frontal sinus as described by K. Beck (*Arch. Ohren- Nasen- Kelkopfh.* 142:205, 1937) not only for the relief of acute frontal sinusitis but as a useful procedure in determining whether a case requires surgery. By pushing a trocar through the frontal sinus wall, the cavity can be aspirated and irrigated, and the patency of the nasofrontal duct can be evaluated.

Listing 38 cases, the author reports 5 acute cases recovering completely, 9 out of 10 subacute cases recovering and only 1 just improved, whereas in 23 cases cure was obtained in 13 and improvement in 3. The remaining seven had to undergo radical operation.

The author claims that repeated punctures and irrigation afford one the opportunity of estimating the status of the mucosa of the sinus, whether infected or not, and the degree of patency or obstruction of the nasofrontal duct.

Meyer [136] favors the Beck procedure for draining the frontal sinus in both acute and chronic cases. It was originally described by K. Beck in 1933, and consists of a special trocar and cannula, the sinus being entered by boring through the anterior wall near the medial inferior portion of the sinus. It is also indicated in cases of vacuum headache due to obstruction of the

duct, and for diagnosis in obscure cases. Contraindications are cases of unusually small sinus and in the presence of complications. Because the Beck apparatus was not available in the author's part of the country, he used a dental drill instead and, by fixing the skin with his fingers, has been able to penetrate directly into the sinus through the bone without a preliminary skin incision. The sinus may be irrigated through a cannula (if one can find the hole without the skin incision!) until the duct becomes patent.

[It is doubtful that this procedure would find acceptance in this country, since the approach through the more compact bone of the sinus floor has proved simpler, with less danger of stirring up an osteomyelitis. S. S.]

According to Giuccioli,[137] frontal sinusitis recurring after surgery may be due to involvement of the intersinus partition with involvement of the opposite sinus. In such cases he advises a procedure which is very similar to the Lothrop operation.

Hesse[138] demonstrates a method of providing an epithelial lining for the surgically widened nasofrontal passage for permanent drainage. The frontal process of the maxilla is resected widely as far as the midline and likewise the floor of the sinus. A dermal flap measuring 0.6 to 0.8 mm. wide and 1.5 to 2.5 cm. long is outlined along the line of the skin incision, paralleling it medially. The base of the flap is just above the nasoalar groove. This flap is folded over the lower edge of the surgical bony defect so that the epithelial layer faces the lumen. In some cases the author also uses a mucosal flap to line the medial aspect of the newly formed passage.

The external skin defect is closed by wide undermining and direct suture.

Rowbotham, Clarke, and Hammersley[139] describe a lateral approach to the frontal sinus, successfully employed in the removal of a large osteoma which had eroded the posterior wall of the sinus. A curvilinear incision from the external angle of the orbit upward and backward over the frontotemporal area exposes the temporal muscle, which is severed anteriorly, and the flap is turned downward exposing the external angular process, malar bone, and part of the temporal fossa. A burr hole through the latter exposes the dura and permits removal of the posterior plate of the sinus and its external prolongation. A large osteoma in this case was easily loosened from its base and removed. This procedure affords the surgeon a wide enough exposure to permit thorough inspection of the tissues surrounding the growth. The interior of the sinus and a wide expanse of dura are thus open to view.

The original site of a malignancy involving the frontoethmoid region can only rarely be defined because these cases when first seen already involve more than one sinus. According to Smith and associates[140] there are very few five-year follow-up series reported in the literature. Reports varying from almost 100% cures to as low as 13% indicate the diverse criteria that were employed.

The authors describe an operative technique in which a hinged temporal bone flap and a skin incision almost encircling the orbital opening permit removal en bloc of the entire orbital contents along with the surrounding bone. The specimen in one case that is shown included the frontal sinus, ethmoid cells, anterior wall of the sphenoid, medial one-third of the superior wall and floor of the orbit, including all of the orbital contents, the medial wall of the antrum, all of the turbinate on the one side, and the septum. The raw exposed area was covered with a skin graft and retained with packing, while the overlying bone and skin flap were sutured.

Woods[141] aims to obliterate the frontal sinus in chronic cases. Success depends on several steps in the technique which he stresses. These are the complete removal of every vestige of mucosa from the sinus, including the duct. He warns against using curettes or sharp instruments to accomplish

this and relies on dissection with gauze. If the membrane is adherent it can be loosened by the application of trinitrophenol (picric acid). The ethmoid cells are not cleaned out unless there is rank infection. The sinus is entered through the floor. After the mucosa is removed, the duct is probed with a fine flexible probe which pulls a strip of gauze after it into the nose. Successive strips of increasing thickness are pulled through in order to strip the mucosa completely without traumatizing the bone. The cavity is packed lightly with gauze sprinkled with penicillin powder. This is loosened in 24 hours and removed completely in 48 hours. The cavity is then presumed to gradually fill with blood. Granulations spring up, fibrosis occurs, and the cavity gradually becomes obliterated. Postoperative infection is usually mild and is readily controlled with antibiotics, so that within a few days the space is sterile.

Goodale[142] advises complete obliteration of the frontal sinus in cases where the Lynch and other procedures are not indicated because of severe trauma to the area, chronic osteomyelitis, and a history of previous unsuccessful attempts to cure the disease. The anterior wall, floor of the sinus, and bony septa should be removed along with the mucous membrane. Also the ethmoids must be removed completely. The posterior bony wall is not removed unless obviously diseased, or there are indications pointing to some endocranial involvement. Postoperative deformity can be successfully corrected by living bone graft. Several cases are described which prove his point.

Dr. Bergara[143] has long been an advocate of the osteoplastic method of exposing the frontal sinus. In recent years he has developed a technique which combines this procedure with the postoperative implanting of abdominal fat into the exenterated sinus cavity. This procedure ensures the complete obliteration of the cavity, thus preventing recurrence of the infection while at the same time the normal contour is maintained. This article describes in detail the entire procedure, with ample illustrations. He also shows slides of sections of the frontal bone with implanted fat after a number of months, indicating that the implant is not absorbed but, on the contrary, becomes fibrosed through ingrowth of tissue from the denuded bone. In 34 cases, many of them bilateral, it was necessary to reoperate on only two, one because some mucosa had inadvertently been left behind and the other because of the development of a mucous cyst.

The author recommends this operation in connection with the transantral ethmoidectomy for the cure of chronic pansinusitis. It can all be performed at one sitting.

Hirsch[144] calls attention to some errors in Hofer and Fioresi's article on decompression of the orbit for malignant ophthalmos. Meesman in 1939 demonstrated a case before the German Northwest Ophthalmologic Society, in which Seiffert did a decompression operation erroneously quoted by Hofer and Fioresi as having been done in 1922. Further, Hirsch cites Sewell's article published in 1928, in which he describes a transsphenoidal approach to the optic foramen but in which no mention is made of its employment for the relief of malignant exophthalmos. They quote the following from Sewell: "There are a number of pathologic conditions for which such an operation as herein outlined might be useful. I mention optic neuritis, optic tract tumors, and constriction of nerve by the optic canal or by fracture through its wall." Sewell's procedure was not mentioned in connection with exophthalmos until 1936 (ARCHIVES OF OTOLARYNGOLOGY).

Hirsch claims priority in suggesting decompression by citing his presentation in 1930 (*Monatsschr Ohrenh* 64:212 [1929-1930]).

Leroux and Chavdin[145] describe two cases of recurring sphenoid sinus infection in which a multiplicity of operations had been performed without curing the patients. Scar formation with recesses in which infection persisted and recurred, resisted vari-

ous surgical procedures until finally they cleaned the areas out thoroughly and then lined the cavity with a dermoepithelial graft. In both instances the graft took and the cavities remained open.

Tamura,[146] on the basis of 30 cases, concludes that the transantral approach to the sphenoid sinus is not difficult and the sinus can be adequately opened and cleaned out without danger in all cases. Naturally, the degree of pneumatization has much to do with the procedure, since well-pneumatized sinuses afford more room for manipulation than the less developed. Measurements made by the author establish the fact that after passing the anterior wall of the sinus a probe will penetrate an average of 1.46 cm. in females before impinging on the posterior wall, the median wall, or the floor. He has found that the average distance from anterior nasal spine to posterior wall of the sphenoid is 9 cm. in males and 8.3 cm. in females. The author comments on the observation that the mucosa of the sphenoid is more sensitive than that of the ethmoids and that it presents a shiny milky-white luster. Another observation by the author has to do with the association of ethmoid disease with the sphenoid. In most cases of the latter, the ethmoids will also be affected, whereas the reverse is not true, namely that sphenoid disease frequently accompanies an ethmoid infection.

The author suggests that in case of doubt as to whether the sphenoid has been adequately opened, a gauze strip impregnated with a contrast medium be packed into the cavity and an x-ray picture be taken.

Furstenberg and Blatt [147] discuss the clinical features of chromophobe pituitary adenomas and favor the transsphenoidal approach over the more hazardous frontotemporal cranial. The tumor is usually soft and cystic and should be curetted without any attempt at total eradication.

Nonsurgical Therapy

Grimaud [148] oversimplifies sinusitis by offering the following observations: from the clinical point of view sinus infections are acute or chronic; from the etiologic standpoint they are either nasal or dental, the former being usually acute and the latter chronic; from the therapeutic point of view acute sinusitis is a medical problem, whereas chronic infections are surgical.

On the basis of this classification, the author proceeds to elaborate the details of the various subdivisions in each of these categories, such as the acute grippal type of sinusitis, the seasonal type, which is a part of a general respiratory infection, sinusitis due to swimming and diving, sinus complications due to barotrauma, sinus complications of dental origin, and, finally, allergic sinusitis.

In discussing medical treatment, he emphasizes the importance of proper head posture when using nose drops, and then offers a list of various medicaments combining anesthetic, antibiotic, and vasoconstrictors. Also he suggests aerosol inhalations, going back to the use of menthol, benzoin tincture, eucalyptus, etc. If one is looking for a potpourri of nasal medications, he can find it in this article.

A five-year clinical study of upper respiratory infections prevalent in Western Texas throughout the year was conducted by Bischoff,[149] resulting in a plan of therapy that has proved efficacious. The patients received 300,000 to 400,000 units of penicillin I. M. every 48 hours and nose drops containing 200 units of bacitracin with 150 TRU of hyaluronidase (Wydase-Wyeth). Encouraged by the good results attributed to the Wydase, a solution with wider antibacterial coverage was got up to combine bactericidal as well as bacteriostatic agents. This solution contained bacitracin, neomycin, polymyxin B and hyaluronidase, with a vasoconstrictor mephentermine sulfate. This has since been produced by Wyeth in the form of a spray.

Daggett [150] treats acute sinusitis by generally accepted methods. In severe cases he gives "sulfatriad" (sulfadiazine 0.185 gm., sulfathiazole, 0.185 gm. and sulfamera-

zine, 0.130 gm. in each tablet) orally and twice daily injections of 300,000 units of "distaquaine" (procaine penicillin G). Irrigation of the antrum is done when the acute symptoms subside.

Indications for surgery in chronic cases are mostly on the conservative side.

Chronic sinusitis in children is treated by irrigations at weekly intervals, usually under local anesthesia, although some surgeons prefer to give the children an additional barbiturate. Displacement therapy is a useful adjunct but not to be relied upon exclusively. Emphasis is placed on general therapeutic measures, hygiene, and attention to possible allergic factors.

At times grossly enlarged adenoids may interfere with proper ventilation and drainage. They should be removed and, at the same time, antrum puncture should be done, with insertion of small polyethylene tubes for drainage and irrigation.

Daners [151] uses a combination therapy of supracillin (penicillin plus streptomycin) I. M. and echinacin I. V. in cases of chronic suppurative maxillary sinusitis that resist the usual treatment or that recur following surgery. The patient must be put to bed during the course of treatment, which is carried on for ten days. Both drugs are administered daily, the dose of the supracillin not being specified. The echinacin is started at 0.4 cc. and increased by the same amount daily as tolerated. Reactions to the latter, consisting of fever and malaise, usually subside after the first three or four injections.

The theory behind this regimen is the fact that the echinacin stimulates the reticuloendothelial system, thus enlisting active antibacterial resistance which increases the effectiveness of the antibiotic. X-ray pictures taken several weeks later demonstrate the resolution of the sinus infection, confirming the improvement in the symptoms.

Krejci and Fischer [152] checked 50 cases of chronic suppurative maxillary sinusitis following treatment by local instillations of various antibiotics. Their purpose was to determine whether the disappearance of bacteria in the washings meant that the infection was really cured. X-ray pictures taken at this time showed that in one-fourth of the cases the sinuses were still cloudy, and the instillation of contrast media revealed either a fibrous infiltrated mucosa or a polypoid membrane, both of which were confirmed by biopsy. The conclusion, therefore, is this: Irrigation fluid returning clear and negative for bacteria does not necessarily mean that the infection is cured. One should always have roentgenographic proof.

Argicillin is the result of a process of detoxifying gramicidin by means of formic aldehyde, resulting in a white powder readily soluble in water. It is less toxic than gramicidin but still possesses marked antibiotic properties. Jusseaume [153] used it in cases of sinusitis and tonsillitis by instillation and by aerosol and claims that it is superior to penicillin. In addition to its being less toxic, it is less irritating when used locally and less likely to produce allergic reactions.

Alos [154] relates his experience in the treatment of sinobronchial conditions by combined local and hypodermic therapy with autovaccines. In a series of 150 cases treated from 1950 to 1954 he lists only 35 in which recurrences necessitated repeat therapy. The list includes sinobronchitis, sinobronchial asthma, purely allergic sinusitis, chronic rhinitis, tubal catarrah, and ozena. Cultures were taken from the nose and throat, and the resulting vaccines were given in increasing doses hypodermically. In addition, the vaccine is administered by aerosol. Also in some cases the author employed a procedure he credits to Manzaneti, called *Bloques intrasinusal*, which is simply the injection into the sinus of an ampule of high potency vaccine. He claims dramatic results in some cases within a few hours, due to the sudden breaking of the allergic chain. Antibiotics may be given along with the vaccine.

"An account is presented of the treatment of chronic inflammation of the

maxillary sinus with streptokinase and streptodormase in 25 patients [Houstkova and Kubelka [155]]. Eighteen patients recovered, four were improved but not cured. The remainder discontinued treatment. The treatment with SK and SD was always combined with antibiotics administered generally as well as locally, the antibiotics being chosen in accordance with the sensitivity of the tested flora. Prolonged application of SK and SD may lead to local reaction of the mucous membrane and to a raised proneness to hemorrhage. In the experimental part it was confirmed that SK and SD have no antibiotic effect nor do they raise nor lower the effect of the common antibiotics. In the experiment SK and SD do not, on first application, affect even the most delicate tissue of the anterior ocular chamber of the rabbit; on repeated application, however, a stronger reaction of an immunologic kind takes place. By a delicate precipitation method a la Oudin, antibiotics were successfully demonstrated in the rabbit's serum following repeated applications of SK and SD. The use of SK and SD in chronic empyema of the maxillary sinus should be regarded as no more than a good auxiliary means which by their fibrinolytic action and lowering of the viscosity facilitate the irrigation of the maxillary sinus and thereby a more direct and more effective action of the antibiotics employed."

Blegvad [156] finds Hebacetin very effective in the treatment of maxillary sinusitis, both acute and chronic. This antibiotic seems to be quite a favorite in Scandanavia (see last year's review). It is a combination of neomycin and bacitracin possessing little toxicity, it is claimed, and showing no tendency to induce bacterial resistance. In 38% of the cases treated, recovery has been observed after one irrigation followed by the instillation of Hebacetin. The preparation is marketed by H. Lundbeck & Co., of the microbiologic laboratories in the state serum institute.

Bethman [157] found Xanthocillin a wide-spectrum antibiotic very effective even in high dilutions. However, because it was found to arrest ciliary activity for a period of time and to provoke allergic reactions, experiments were carried out on the tongues of frogs to elaborate a means whereby the ciliary activity and capillary permeability could be promptly restored, thus enhancing the effectiveness of the mechanism for expelling the products of the infection. These experiments resulted in the finding that a mixture of 40% Tibatin and 10% urea equal parts produced the best results.

Rodriguez and associates [158] differentiate between the action of antibiotics and bacterial enzymes in infections. While the antibiotics are known to interfere with the metabolism of the bacteria, the enzymes act on the extracellular elements, modifying the medium so that the bacteria are unable to survive.

They used streptokinase, 15,000 units, and streptodormase, 3000 units, instilled into the antrum after irrigation. The patient must then lie on his side of the antrum treated for three hours. The treatment may be repeated in 12 to 24 hours and, as a rule, only three to four instillations are needed to effect a cure. Considerable inflammatory reaction appears following the treatment. There is a copious discharge of purulent material, which gradually changes in character and consistency, eventually becoming thin, clear, and serous.

Flechsig [159] treated 156 cases of antrum infection by instilling 250 mg. of Terramycin suspended in 2 cc. of olive oil. In the vast majority of the cases only two or three instillations were required to cure the infection. Two cases received 10 instillations without any benefit and were subsequently operated upon.

Schnurbusch [160] states that before deciding on the local use of antibiotics in antrum infections, one must ascertain whether the process can subside under simple irrigation therapy. If antibiotics are to be used, the choice must depend on the sensitivity of the infecting organism. Therefore, at the very first irrigation, a bacterial analysis is done, including sensitivity tests. After the

third simple irrigation the clinical picture as well as the bacterial analysis can well determine whether the infection is going to subside without the aid of antibiotics. Should this not be the case, then the appropriate antibiotic (preferably penicillin) is instilled. The author uses a suspension of 300,000 units of procaine penicillin in 5 cc. of sesame oil. As a result of this procedure, there has been a marked reduction in the number of radical operations on the sinus.

Nopenol is an oily penicillin suspension, 300,000 units in 5 cc. It is non-irritating and well tolerated in the tissues. Rüdiger [161] used it by instillation into the antrum in 48 acute and subacute cases, of which 9 were subsequently operated upon, 19 treated many times, and 20 treated only once or twice. There were no reactions or side effects.

Pressomin is aliphatic aromatic amine with a vasopressor action. It is the trade name for Methoxamine put out by the firm "Gea" in Denmark. Schmidt [162] reports his results in a series of 130 patients between the ages of 2 and 78. The drug was used in the form of nose drops (0.25%) and by displacement (0.01%). The preparation is buffered to a pH of 6.0 and cetyl pyridine added for its bacteriostatic effect and reduction of surface tension. It was used in the treatment of acute and chronic sinusitis, vasomotor rhinitis and acute rhinitis, with favorable results and no side effects.

Miller et al.[163] demonstrate the effectiveness of Alevaire aerosol inhalations in dissolving and facilitating the elimination of secretions in the sinuses and bronchi. The open-top tent method for overnight therapy and the direct application of a nebulizer are both illustrated. Seventeen case histories are submitted.

Netto [164] claims excellent results from the use of Anapyron in cases of frontal sinusitis, headache of nasal origin, and ozena. The drug is a vegetal which was promoted by Dr. Mangabeira-Albernaz and is likened to the antibiotics in its action. It is impregnated in powder form into a wad of cotton which is inserted into the nares, the patient inhaling it with mouth closed for 15 to 30 minutes once or twice daily. The author states that headaches are relieved promptly and that within a few days the odor and secretions are markedly diminished.

Wessely [165] recommends Pontocaine in combination with a vasoconstrictor as a spray or pack treatment in acute sinusitis. Also to promote drainage he favors the use of a heat lamp. He mentions Omnadin as being useful in increasing resistance to the infection; also the various antibiotics. Irrigations should be carried out as soon as the very acute symptoms subside. In the chronic cases the irrigations have to be done frequently and followed by instillation of penicillin (70,000 to 200,000 units in 12 to 15 cc. of water). In resistant cases it may be well to subject the offending bacteria to sensitivity tests before resorting to other antibiotics. Recently he has had good results from antibiotics incorporated in gelatin.

Conservative measures will relieve most of the cases. Surgery is indicated if the discharge persists, if it is malodorous, or if there are general manifestations which might be referable to a focus of infection.

Schule [166] found that by impregnating a gelatin preparation (Gelita "Sinugel") with penicillin and instilling it into the antrum, it was possible to prolong the action of the antibiotic and shorten the duration of treatment. It was used in 160 cases of empyema of dental origin. Treatment was shortened from an average of 9.3 to 5.5 days and the number of irrigations reduced from 6.4 to 2.6. In only 24% of the cases was surgery required.

Penicillin, 200,000 units, and Badional were added to 3 ml. of gelatin. The Badional was found to be effective against penicillin resistant organisms such as B. coli commune, pneumobact. Friedlander, and B. pyocyaneus. When the discharge was fetid he added 5% Centa (a chlorophyl)

and in the case of anaerobic bacteria Marbadal (0.5 gm.) was found to be effective.

The gelatin solution was warmed and liquefied and then instilled through a Lichevitz needle. It usually solidifies at body temperature within ten to fifteen minutes.

Elsen[167] does not agree that penicillin solutions in concentrations exceeding 2000 units per cubic centimeter are harmful when instilled into the antrum. He has used penicillin G procaine, 600,000 units per cubic centimeter, with excellent results in 44 cases. It was found that the acute and subacute cases responded promptly to not more than four instillations. Even in the chronic cases 73% of the 11 treated were cured. He found it advisable to instill the solution after irrigation via a turbinal puncture. In no instance was there any allergic reaction and so far as damage to the mucosa was concerned he observed no ill effects, since the sinuses functioned normally after recovery. Despite the evidence of harmful effects of high concentrations in the nose of experimental animals, the author claims that there is nothing in the literature to indicate similar ill effects on the mucosa of humans.

He points out also that the instilled penicillin 600,000 units to the cubic centimeter becomes diluted in the residual irrigation fluid so that in effect it is reduced to approximately 50,000 units per cubic centimeter.

Lathrop and associates[168] report on the early results of treatment of malignancies of the head and neck with a 2,000,000 volt x-ray apparatus. The advantages of this medium over the conventional 200 kv. and 400 kv. machines are that the skin erythema develops much later, depth dosage is much greater, and the amount of radiation that can be delivered is also higher. Patients tolerate the therapy much better, being able in most cases to carry on with their work during the treatment. It was also found that patients requiring surgery subsequent to the treatment were able to undergo the procedure with fewer complications. Seventeen cases of malignancy of the nose and sinuses were treated from 1949 to 1954, of whom seven were still living. Four cases treated in 1949 and 1950 had succumbed to the cancers.

Unger[169] was impressed with the observation that penicillin seemed to be more effective in cases associated with fever. He therefore induced fever in some cases of chronic sinusitis and otitis media by intravenous injections of typhoid vaccine. The first dose, however, though very small, produced a severe reaction necessitating the hospitalization of the patient. Subsequent injections were less severe. Later he gave the typhoid vaccine intramuscularly with less severe reactions so that the patient could remain ambulatory. The penicillin (600,000 units daily) was started immediately after the typhoid injection, which was usually repeated at intervals of seven to fourteen days, depending on the degree of reaction.

Five cases of chronic sinusitis with demonstrable pus, which had resisted other therapy, were cured under this regimen. To cases cleared up after one dose of the vaccine, two after two doses, and one after three doses. Temperatures of from 101 to 105 F were recorded after the initial injection.

Clinical—General

Lodge[170] goes through a long list of otolaryngological affections, giving briefly the prognosis based on knowledge of the course of the disease and the therapeutic agents most applicable. One may not agree with some of the observations, but, on the other hand, the author has much to say that makes sense. He speaks of enlarging the natural ostium in doing a Caldwell-Luc operation rather than relying on an artificial opening in the inferior meatus; also of removing the tissues from which polypi "take their roots," and of repairing a depressed nasal dorsum with a hinged bone cartilage graft, all of which are debatable.

He calls attention to the value of testing the olfactory sense before undertaking a

nasal operation, the importance of differentiating lime salt deposits from mucosal thickening in x-ray films of the sinuses, excluding chronic glaucoma or intracranial growths before operating for the relief of neuralgia, how and when to ligate in cases of recurring hemorrhages from the nose, etc., hints which help to forecast the outcome of the affection. There has been very little literature on the subject of prognosis. This article, therefore, is refreshing.

Hampsey [171] credits better understanding of the problem of chronic sinusitis to three factors, namely, recognition of the basic physiology of the nasal apparatus, appreciation of the role of allergy, and the intelligent use of antibiotics.

Maxillary-Dental Complications

Thomson [172] reports a fatal case of air embolism following antrum puncture under general anesthesia in a 5-year-old boy. When the needle was inserted on the one side (left) it was felt to strike the posterolateral wall of the antrum. The needle on the other side (right) was inserted without difficulty. Saline solution was introduced through a Higginson syringe and irrigation successfully carried out in the right antrum. When the same was attempted on the left side, resistance was encountered and only a few drops of solution emerged from the sinus. The syringe was disconnected and an attempt made to inject air into the sinus to displace the accumulated fluid. Resistance was encountered and the patient suddenly ceased to breathe, became ashy gray and his pupils dilated widely. Artificial respiration, intracardiac injection of epinephrine, and cardiac massage all failed.

Autopsy revealed normal brain, meninges, and vessels. Considerable quantities of air were found in the right auricle, ventricle, and pulmonary artery.

The author comments on the use of air following irrigation, a practice he has since abandoned.

Kowal, Singh, and Borkenhagen [173] present a very instructive analysis of odontogenic conditions which may give rise to symptoms referable to the ear, nose, and throat. Otitic and facial pains may be due to a pulpitis, which can be diagnosed by the response to thermal stimuli. Postextraction pains may be due to an osteitis which usually subsides in about 14 days. Pain due to impacted teeth can be diagnosed properly through x-ray studies.

Temporomandibular joint disturbances are not always due to malocclusion or local arthritis but may be caused by traumatic or inflammatory processes involving the ligaments and temporal muscle attachments. Localized tender points and the response to injection of a local anesthetic are helpful in the diagnosis.

The authors go further by discussing the various space abscesses due to tooth infection, oroantral fistula, facial trauma, and odontogenic tumor, all of which give rise to symptoms referable to the ear, nose, and throat. It is well that these relationships be borne in mind when symptoms arise which are attributed to areas beyond the dental apparatus, which is so often the real seat of the trouble.

Lorenz [174] finds that infection frequently arises from a diseased tooth and then travels by way of fine communicating vessels into the floor of the antrum. Extraction of the tooth in most cases is followed by subsidence of the antrum infection. However, in many cases, because of lowered resistance or unusual virulence of the infective agent, the infection in the mucosa of the antrum floor persists and either gives rise to local pains or more frequently acts as a focus of infection causing various neurologic disturbances and arthritic complications. The diagnosis is not easy, because x-rays fail to show any changes and irrigation is fruitless.

The history is of importance, even though the extraction was performed some time previous. Having such a history dating the onset of the symptoms and noting recurring attacks, it is advisable to open the antrum and investigate its floor. Palpation

will reveal an area where the mucosa is soft and thickened.

The author has seen 200 cases of this type in a period of 12 years. Of these, 169 suffered neuralgic and rheumatoid manifestations which were relieved by surgical removal of the diseased mucosa.

Burman [175] offers some helpful data in connection with the diagnosis and treatment of sinusitis of dental origin. It should be suspected if there is no evidence of a preceding rhinitis, the symptoms are unilateral, there is a history of recent tooth extraction, there is foul discharge from the nose, and there is some localized pain or unilateral headache.

If a fistula is demonstrated after an extraction, the wound should not be irrigated, and sponging should be avoided; gentle suction may be employed, and a clot should be encouraged to form and fill the opening. The soft tissues should be promptly sutured and the patient instructed to clamp down on a sponge covered with petrolatum over the wound for ten minutes to ensure a firm clot. The patient should refrain from blowing the nose and smoking, and the use of mouth washes is banned for several days.

Recovery of displaced tooth roots in the antrum and the treatment of subsequent antrum infection can be taken care of adequately only through a Caldwell-Luc operation.

Rachet [176] poses the question whether it is possible to foresee and prevent the formation of an oroantral fistula. To be able to do this would avoid embarrassment to the dentist, who is frequently surprised at the happening, and to the otolaryngologist, whose treatment of an infected sinus is unsuccessful because of the dental mishap.

The etiology of an oroantral fistula is based on two possible factors. The one has to do with the anatomical conformation of the parts and the other with the dental lesions which may be the inciting cause. The latter include such items as apical granuloma, apical cyst, and bony changes due to paradontitis. It all adds up to careful analysis of the history and the local factors as determined by thorough and complete x-ray study.

Beckdorf and Sonnabend,[177] in analysis of 1071 extractions, came up with some interesting findings. They found that perforations into the antrum were most commonly due to extraction of the first molar, which is contrary to the general opinion that the second molar is the most frequent offender. Another fact which they discovered was that perforations were far more commonly associated with extractions of devitalized teeth than of vital teeth. Although they caution against probing or traumatizing an alveolar fistula, there are times when the diagnosis can be made only after the patient blows his nose. Passing a silver-tipped probe under such circumstances may be necessary. In most cases the alveolar socket is not to be tampered with but permitted to fill with blood to form a coagulum.

Another point brought out by the authors is the fact that the absence of adjacent teeth had no influence on the incidence of perforations.

Finally it was shown that perforations are commoner in males than in females.

Eschler [178] finds that perforation of the antrum floor caused by extraction may be due to unusual thinning of the bone in this region. This may be the result of several factors which tend toward inequality in the action of the masticating muscles. These are listed as lateral deviation of the mandible, unilateral loss of teeth, congenital inequality of the muscles, and muscle weakness. As a result, there are differences in the thickness of the intervening bone. Electrical action potentials of the masseter muscles reveal the differences that have been observed in the two sides.

The author claims that foreknowledge of such conditions may warn the extractionist of the possibility of perforating into the antrum, even when the x-ray pictures fail to reveal the true status.

Bonorden [179] reviews various procedures for treating complications arising from the extraction of teeth whose roots are close to the antrum floor or perforate it. If the sinus mucosa has not been lacerated, the alveolus will heal if it is not disturbed. The important thing is to permit a blood clot to form and to protect it by a pad or a prosthesis. Occasionally primary suture may be employed. A displaced root fragment which has not been pushed into the antrum is best removed through an alveolotomy. This is much less dangerous than attempting to remove it through the open socket, a procedure by which the fragment may be pushed into the antrum.

The author discusses prophylaxis, laying emphasis on the preextraction diagnosis in properly executed x-ray projections. This topic has been thoroughly covered by other articles in this and the previous review.

Several typical cases are cited with accompanying illustrations.

Johnson [180] has devised a retractor which will engage the bone just under the periosteum in the Caldwell-Luc exposure without slipping. Also it is equipped with a pistol grip handle which affords a firm hold.

Sakar and Sarpyener [181] report a case of odontoma in a 10-year-old boy. A tooth abscess six months previously ruptured and left a draining fistula. Biopsy was reported as indicating "osteitis fibrosa." A Caldwell-Luc operation was performed, revealing a spherical porous mass the size of a hazel nut. The histologic report was "fibrous tissue in abundance, cubic epithelial cells, and substantia detinae stained in a rose pink color, cement and lacunae." The diagnosis was mixed odontoma.

These growths arise from the dental papilla, present in the alveolus or tooth apex, and consist of epithelial plus fibrous tissue.

Holier [182] claims that retention cysts of the antrum may be due to apical infection of a tooth without actual perforation. The inflammatory reaction in the area above the affected tooth may cause a localized swelling of the antrum mucosa, whereby the gland ducts are obstructed, causing a retention cyst. He shows some histologic sections of this mucosa in a case of a fractured tooth with absorption of the pulp.

Rohrt [183] "calls attention to the very frequent invasion of the maxillary sinuses by bacteria from the upper respiratory tract, compared with mycotic infections, which occur rarely. In addition, a case of maxillary sinusitis most likely due to Aspergillus fumigatus is reported."

Frontal-Ethmoid-Sphenoid

Vialatel's [184] case is of interest only from the point of view of the harm that can be done through obsolescent and inadequate therapy. After extraction of a molar the antrum became infected through perforation of the tooth socket and was treated by repeated irrigations through the alveolar opening. The infection spread to the frontal sinus and perforated into the soft tissues. This was treated by puncture and irrigation according to the method of Lemoine. There was a temporary recession of the symptoms for several months, with recurrence necessitating several more irrigations and instillations with antibiotics.

The author was apparently very loath to do any surgery, which he claims might have been multilating and unesthetic.

Riccabona [185] claims that there are a certain number of cases of allergic rhinitis which are due to a bacterial allergy. One can always discover in the history of the case that the trouble began after an attack of acute sinusitis at some previous date. The infection fails to clear up and the tissues become sensitized to the offending organisms. Antihistaminics and decongestants afford only temporary relief. The author has found that in these cases the infection resides in the ethmoid cells and can be diagnosed by planigraphy and by the presence of edema and frequently polypi in the middle meatus. As a rule, the antrum and other sinuses are negative except in prolonged cases. Blood examinations nearly

always reveal an increase in the eosinophils. A cure can be obtained by opening into and cleaning out the ethmoids. The author cites a number of cases and shows some histologic sections demonstrating typical allergic reactions in the mucosa. Also he mentions the use of autogenous vaccines, citing Bishop, Duke, and Moore.

Harrison [186] reports three cases of expansion of the frontal sinus. In all of them there was a definite prominence over the affected sinus and headache was not a prominent symptom. In one case it was found that by puncturing the affected sinus and instilling contrast medium, the fluid escaped from the nostril on the unaffected side. An osteoplastic flap was created, exposing the dilated sinus and the communication with its fellow through a fair-sized hole in the partition. The opening of the nasofrontal duct could not be located. The intersinus septum was removed and the osteoplastic flap split and replaced so as to eradicate the external deformity.

Porter [187] reports a case of acute frontal sinusitis in a 16-year-old boy, which receded under the influence of antibiotics but flared up at the end of three weeks, with symptoms pointing to intracranial complications. Paralysis of an arm and leg with signs of meningeal irritation indicated a cortical focus. Operation disclosed a suppurating frontal sinus, erosion of the posterior plate, and an epidural abscess. Marked improvement followed, but after several weeks a convulsion and recurrence of the paresis led to a second operation, at which time a cerebral abscess was found anterior to the motor area, also extensive osteomyelitis. Drainage and antibiotics led to recovery.

The author emphasizes the masking effect of the antibiotics in the early stages of the disease.

Pfister [188] discusses three types of chronic sinusitis: suppurative, hyperplastic, and allergic. Suppurative sinusitis is more frequently found in the maxillary sinus because of its position and size. Hyperplastic sinusitis may involve any or all of the sinuses, is often considered of allergic origin, and is usually not associated with much discharge. Allergic sinusitis manifests itself during periods when the patient is exposed to the allergens to which he is sensitive. The various well-known diagnostic procedures are described.

Suppurative sinusitis usually requires surgery, the extent of which depends on the degree of involvement of membrane and bone. Hyperplastic sinusitis will yield to conservative treatment, which includes antibiotics, cortisone, and autogenous vaccines. Allergic sinusitis requires study of the patient's environment, diet, etc., with appropriate antiallergic measures.

A case of acute myeloid leukemia reported by Dawes and Levene [189] was in the beginning mistaken for an acute frontal sinusitis. After an acute upper respiratory infection the patient complained of pain around the eye and swelling. There was an enormous bluish swelling of the periorbital tissue and some swelling in the middle meatus, also slightly discolored. A trephine opening through the floor of the frontal sinus yielded pus under pressure. Shortly thereafter the patient vomited some blood and became very restless. Petechiae appeared on the arms and more hemorrhage from the bowel. Despite antibiotic therapy and transfusion, the patient died. Autopsy revealed generalized petechiae, enlarged lymph nodes, and leukemic infiltration of the spleen, liver, kidneys, heart, and other organs. There was also infective meningitis with leukemic infiltration.

Within a period of one year Bues and his associates [190] operated on 15 patients for lesions which they call the sphenoid syndrome. These included six meningiomas, one meningioma of the tuberculum sellae, one cylindroma of the sphenoid, and seven cases of arachnoiditis chiasmatis. The last were often difficult to differentiate clinically from tumors because of the x-ray shadows caused by fibrous bands with inclusion cysts.

These cases are of interest to otolaryngologists because the symptoms of headache

and ocular disturbances with frequent displacement of the bulb are suggestive of sinus disease. The diagnosis is made by fundus studies and x-rays. Two x-ray pictures are shown, one revealing osteoporosis of the sphenoid bone extending into the greater wing and the other showing an osteosclerosis and advancing meningioma.

Three cases of isolated empyema of the sphenoid are reported by Faltynek,[191] one of which was complicated by a thrombophlebitis of the cavernous sinus. Staphylococcus aureus was recovered in two cases.

The author offers the following as the chief items in the diagnosis of this condition: (1) severe pains in the occipital region radiating throughout the skull; (2) pus in the olfactory groove and (3) positive findings in the x-ray pictures taken in the axial and lateral projections.

Allergy

"Allergologic Problems in Otolaryngology" is a collection of 13 articles by various authors covering all phases of allergy as related to otolaryngology.

Pietrantoni and Pazzini cover the subject of surgery in hyperplastic polypoid sinusitis. Their observations are based on a study of 63 cases. The cases are divided into three groups: the clearly allergic nonsuppurating type, in which surgery is not to be considered; the probably allergic with superimposed bacterial invasion, in which radical surgery is indicated when all other measures have failed, and the predominantly infective type, where exenteration by the transantral approach is the method of choice. The authors call attention to the value of postoperative intracavity irradiation in the surgical cases as a means of preventing recurrences.

Caprani and Clerici emphasize the conception of an allergic diathesis in which the mucosa is sensitive to various influences aside from allergens and which increases rather than diminishes with years. Diagnosis therefore rests on an analysis of the family history as well as the patient's history. Antihistaminics are useful in all of these parallergic rhinopathies.

Clerici pursues this subject further by analyzing the hereditary factors in the transmission of this diathesis. Four hundred ten patients with various allergic rhinopathies were studied from this point of view and divided into three groups: 102 with seasonal allergy, 208 with perennial allergy and 100 with rhinopathy, probably allergic. He found the family history confirmatory in 50% of the seasonal cases and in 76% of the other groups. Familial allergic rhinopathies were found in the following order: asthma, urticaria, pollen sensitivity, and Quincke's edema. Probable allergic conditions are listed as arthritis, chronic nasal catarrah, hemicrania, eczema, and colitis. These items are all tabulated in the three groups mentioned above.

Pursuing the subject further, Clerici and Villati submit a triad of diagnostic procedures which are of value in a study of the allergic diathesis. These are arterial hypertension, hyperreflexia, dermography and eosinophilia. They found these criteria positive in 96% of a group of 80 patients, both seasonal and perennial cases, when considered under certain restrictions. A summation of the degree of deviation in the various categories mentioned above is what they consider significant, rather than a positive finding in only one.

The next article, by Clerici and Sambataro, is an analysis of 137 patients suffering from seasonal allergies, and considers all the factors, such as age of onset, social status, occupation, environment, and relationship to previous nasal complaints. The various pollens responsible are listed and their incidence in the responses to skin tests. Desensitization was carried out over a period of years and the results summarized. The figures show that the percentage of complete recovery was much higher after three years of treatment than after the first or second year.

The subject of molds is considered by Sambataro and Clerici, who confirm prev-

ious reports on the incidence and pathogenetic potentialities of these agents. They collected dust from the habitations of 61 patients and classified the various molds present. This study proved valuable in the treatment of the sensitive patients in that vicinity (Milan).

A study of the unsaturated fatty acids of the blood in 68 allergic patients by Clerici and Zanetta revealed a lowering of iodine uptake in 53% of the seasonal cases, in 72% of the perennial cases, and in 40% of extra-allergic rhinopathies. They consider the deficiency of unsaturated fatty acids as significant.

Leonardelli discusses the cytology of secretions in allergic patients when studied under the Papanicolaou stain. Seasonal cases show many cylindrical and round elements, nuclei of various shapes, small chromatic granules, foamy cytoplasm, and a large number of eosinophils. Perennial cases show flat cells, with pyknosis and fewer eosinophils than in the other group.

Lecco used cortisone aerosol in two patients with allergic polyposis and reports regression without recurrence after six and nine months. He attributes the result to progressive vascular thrombosis.

Clerici, Pasim, and Sambataro treated 72 patients by submucous injections of antihistaminics. In 33 cases the symptoms disappeared in 2 to 24 months; in 28 the benefit was only temporary, and in 11 it was without any effect. The poorest results were in the seasonal allergies and those associated with endocrine disorders.

The organization of the department of allergy in the ENT Clinic at the University of Milanis is described by Clerici, Sambatora, Ferrari, and Teseo, with statistics covering some 1700 cases. They show the record form for the work-up and follow-up of the ambulatory patients and present a number of graphs whereby the cases are divided into categories covering the various types of allergy. Incidence in the different professions and occupations are also reduced to percentages and catalogued.

It is apparent from the amount of material intensively studied that much valuable information will be forthcoming to substantiate some of the items which have been sketchily abstracted above.

Van Alyea [193] classifies allergic sinusitis into five groups, which include cases of acute suppurative sinusitis on an allergic basis, cases with structural defects and polypi obstructing the ostia, and cases of chronic sinusitis with or without polyps which have been subjected to one or more surgical procedures.

The management of all of these depends primarily on the successful control of the allergy. When combined with the correction of anatomical abnormalities and growths which block the ostia, good results may be expected in the majority of cases. Radical surgery is seldom indicated.

Solari [194] prefers the term "rinosinuspatia" (rhinosinupathy) to "rinitis alergica" because the suffix "itis" implies an inflammatory process, which it is not. Otherwise the article discusses the allergic state in the usual pattern of symptomatology, diagnosis and treatment.

In another article on the same subject, Solari [195] elaborates by describing rhinopathies as two groups, in one of which the allergic factors predominate and in the other of which a bacterial factor is introduced. The purely allergic cases can be diagnosed by injecting epinephrine into the antrums prior to taking x-rays, the result being a prompt shrinking of the lining mucosa and a clear picture. Also a parenteral injection of epinephrine will cause the sinuses to clear when transilluminated. Infection is likely to result in hyperplasia of the mucosa which is less amenable to epinephrine and may at times reveal polypoid masses.

Anderson and Rubin [196] found that among the therapeutic procedures helpful in allergic individuals are use of vasoconstrictors, displacement therapy, hydergine, bronchoscopy, and correction of nasal deformities. Stress is laid on the importance of restoring normal physiology to the nasal

passages, medically, surgically, or by a combination of the two.

Fitz-Hugh [197] states that changes in the mucosa of the sinuses may be found in 75% to 80% of all asthmatics. He discusses various therapeutic measures which are currently employed. These include desensitization, antihistaminics, vasoconstrictors, antibacterial drugs, corticotropin and cortisone, irradiation, and such drugs as calcium and iodine preparations.

Under surgical considerations the author summarizes indications for operation in three categories: pathologic changes necessitating surgery on their own merits; minor to moderate sinusitis in cases of persistent asthma failing to respond to conservative treatment, and cases in which minor nasal procedures such as lavage, polypectomy, etc., have been of benefit. Selection of cases must be carefully made and decided on only after a satisfactory period of observation by both allergist and rhinologist.

The author estimates improvement following minor procedures as about 75%. In cases where major surgery is necessary, the percentage of cases improved is around 50%. It is also pointed out that in the remainder there is the possibility that the asthma will be aggravated in 18% to 20%.

Barotrauma

Dickson and King [198] submit an analysis of their experience in the treatment of otitic and sinus barotrauma in the Royal Air Force personnel. The material comprises 328 cases, of which 100 involved the sinuses. In this group the therapy resulted in 68% being returned to full duty, 17% to restricted flying and 15% grounded. The frontal sinus was most frequently affected either alone or in combination with the antrum. These accounted for 89 of the 100 cases. The initial treatment consisted of decongestive sprays, inhalations or tampons, antrum lavage, antihistaminics, and antiallergic therapy. In 40 cases surgical procedures were resorted to, including submucous resection, antrostomy, Caldwell-Luc operation, frontal sinus drainage, etc. The results were excellent, inasmuch as 77% were returned to full flying.

Deep x-ray therapy was employed in a number of the ear cases but apparently was not indicated in the sinus cases.

The presentation is an interesting and instructive document.

Bertrand [199] offers a long treatise on barotrauma, expanding it to include deep-sea diving, coming out of the Snorkel of a submarine, and pressure tank experiments. He agrees with Campbell that the mechanism of barotrauma is physical and can be obstructive as well as nonobstructive in origin. His pressure tank experiments were characterized by short-lived pain, infrequent epistaxis, and absence of rarity of complications. The pressure tank is useful as a functional test for tubal permeability.

Flottes, Guillerm, and Badre [200] review the literature on barotrauma, which was first described by Paul Bert in 1878 in connection with caisson workers. They assert that the term "aerosinusitis" was first employed by Marchoux and Nepper in 1919.

The two elements necessary for the production of this condition are sudden change in air pressure and obstruction of the ostium. An increase in pressure between 100 and 150 mm. Hg in descent is sufficient to produce an edema with exudate. If the pressure passes 250 to 300 mm. Hg, more serious damage will result, such as hemorrhage, laceration of mucosa, and hematoma. The other factors such as rapidity of descent and status of the ostiums are given in detail.

Immediate therapy consists of recompression with gradual descent, vasoconstrictors, penicillin aerosol, privine with hyaluronidase, and puncture of the sinus. Prophylactic measures described are all well known.

Headache—Pain

Moulton [201] presents an analysis of the psychiatric problems involved in the evaluation of pain in and about the jaws out of

proportion to the status of the dental apparatus. A variety of complaints stemming from personality and environmental problems are listed, such as clenching of the jaws, radiating pains, difficulty in opening and closing the jaws, headaches, tension in the neck muscles, dizziness, choking spells, and other manifestations of anxiety neurosis. A number of the cases seemed to have developed following trauma to the teeth, but in most of them the analysis revealed psychiatric problems which necessitated a thorough study of the individual case—this despite the fact that these patients were looking for dental help rather than psychiatric care.

Vogel [202] discusses headaches arising from sinus infections and tries to describe the pain that is characteristic of the various sinuses. He mentions the morning pain of frontal sinusitis, the accompanying local tenderness in very acute cases, the more diffuse pain and tenderness of osteomyelitis, the facial and temporal pain of maxillary sinusitis, and the vertex and occipital pains of sphenoid disease. Also he calls attention to the pains that may be caused by a high septum deviation pressing on a swollen middle turbinate and the relief which follows the use of vasoconstrictors. Neuralgias of the various divisions of the fifth nerve are diagnosed from their point of origin and their distribution.

King [203] quotes Mother Goose as pertinent to the question of etiology in headaches:

> "For every malady under the sun
> There is a remedy or there's none
> If there be one try to find it,
> If there be none never mind it."

In a study of 460 consecutive patients with headache he found the etiology as follows: neuralgia, 27%; general systemic disease, 17%; vascular causes, 7%; intracranial causes, 4%; sinusitis, 7%, and nothing found 38%. He mentioned yet another group, namely those who go from one doctor to another, receiving various forms of therapy but never being cured. In such cases where no real pathology is found he would advise the above Mother Goose quotation unless one possesses "the divine healing power of Elisha who restored to life the child who died after crying 'my head, my head.'"

Miscellaneous

Cernea, Garlopeau, and Marie [204] state that the triad of pain, trismus, and cardboard induration are the characteristic symptoms of actinomycosis in the temporomaxillary region. However, when the infection is located in the pterygomaxillary area, the cardboard induration does not appear until very late, making the diagnosis difficult. Two cases are cited, one in a man of 42, the other in a woman (age not given). In the differential diagnosis from tumors, bone disease, etc., two points are significant. First, the x-rays and planigraphs fail to reveal any disturbance in the bony structures. Second, it is characteristic of actinomycosis that fistulization takes place through the skin and not through the mucosa, as is the case in simple pyogenic infections. Of the two types of actinomyces, the anaerobic, or Israeli, is the commoner.

Referring to discussion on the subject at the Twelfth Congress of Stomatology in New Orleans, in 1952, where it was stated that the best therapeutic results were obtained from the mycins, the authors found in their two cases that penicillin was more effective than terramycin, tetrazin or aureomycin.

Loss of sense of smell and taste has been reported following head trauma. Transitory abolition of these senses has also been noted from carbon monoxide poisoning. The case presented by Zilstorff-Pedersen [205] was in a woman of 38 who, following a forceps delivery under ether, went into shock with blood pressure down to 90/65 and periods of anoxia. She was revived after appropriate therapy but immediately complained of loss of taste and smell. She failed to respond to the Elsberg tests for smell and the Boernstein tests for taste. Two years after this episode the condition was unchanged.

The question as to whether this paresis was of central or of peripheral origin could not be decided, but the author assumes it was due to cerebral anoxia.

Joyce [206] found that situs inversus was associated with twinning in four of the five cases he had encountered. Similar findings have been reported by others whom he cites. He cites Cockayne (*Quart. J. Med.* 31:479), who believes that situs inversus is transmitted as a recessive characteristic caused by a single autosomal gene.

In the case reported by Wright,[207] although there was a complete transposition of all the thoracic and abdominal organs, no mention is made of the status of the sinuses.

Atav, Goskan, and Ural [208] report a case of rhinosporidiosis in a girl of 12. There was a history of a previous fall into a stagnant body of water. Subsequently there was a nasal discharge and bleeding. A mass developed in one side of the nose which progressed until it protruded from the nostril. It was removed through a rhinotomy and the patient was put on daily doses of 0.3 gm. ethyl stibamine (Neostibosan). There was no apparent recurrence.

Ziyaettin [209] calls attention to a form of hyperplastic sinusitis which is nonpurulent, often of allergic type, causing pains in various parts of the face and a sensation of heaviness. The diagnosis is possible only by x-rays, and irrigation is usually negative. The author claims these cases can be cured only by radical surgery. One case is cited.

Foreign Bodies—Trauma

Parker and Dunn [210] report two interesting cases of tooth fragments in the antrum which were expelled spontaneously into the nose through the natural ostium. The first case ran an irregular course, inasmuch as tooth fragments were present in both antrums; one fragment in the molar region worked its way into the antrum after several months. The authors state that the pressure of a denture during the act of chewing can cause pressure atrophy of the tissue between the foreign body and the antrum, thus facilitating its entrance into the cavity. Infection also would hasten the process.

Extrusion of the foreign body through the natural ostium comes about through the ciliary activity of the sinus mucosa, the posture of the patient in sleep, and the low specific gravity of the object.

Jeschek [211] claims to have found only 15 cases of penetrating foreign bodies into the sphenoid reported in the literature. He adds two which came under his observation.

In both cases the foreign body was a shrapnel fragment. In the first case, which was seen only a few weeks after the injury, the foreign body could be visualized in the x-rays and an attempt was made to remove it endonasally. However, it could not be found at the site indicated. Later the mass was located in the inferior meatus, having been displaced when the bony anterior sphenoid wall was removed and evidently lost in a blood pool.

Bearing in mind this experience, the author resorted to a transantral approach, having localized the object clearly in a planigraph, and was able to extract it easily.

Caligaris [212] reports a case in which two rhinoliths were localized in the maxillary sinus. The pathogenesis is discussed with reference to the results of histological examination of the nasal mucosa, cultural examination of the bacterial flora and a study of the pH of the nasal secretions. The shift of the pH toward alkalinity promotes the precipitation of phosphate salts and calcium bicarbonate. The stasis of secretions, biochemical changes of the tissues, and a constitutional predisposition are etiologic factors.

Marr [213] adds the ninth case of a stone in the maxillary sinus to those previously reported in the literature. There was a history of a tooth extraction some 15 years before, which resulted in a draining fistula. An intranasal antrostomy failed to halt the process. X-rays showed a stone in the floor of the sinus. Just prior to the date set for operation, the "patient was wiping the

fistulous opening with cotton which caught in something." By gently pulling on it she delivered the stone, which measured 16×6 mm. It consisted of combustible organic matter (38%) and calcium phosphate (62%). No nidus was located, but the author concedes that a small bit of tissue or firm exudate may have served as the nucleus.

Lineback [214] reports two cases of wooden foreign body in the antrum. In the first case the patient ran through a thicket, injuring his eye, from which a small twig was later extracted. He had no further trouble until eight years later, when headaches led to examination and diagnosis of antrum suppuration. Subsequently he blew two small pieces of wood out of his nose and, although x-rays revealed a large foreign body in the antrum, he refused surgery.

In the second case a 33-year-old man had been treated for sinusitis over a period of years without result. X-rays with and without iodized oil showed a dark antrum with thickened mucosa but no foreign body. He submitted to a Caldwell-Luc operation, at which time a thin piece of wood measuring about 3 cm. in length was extracted. The patient then recalled that at the age of 5 he was struck in the face by a broken broom handle which he had been pitching into a pear tree to shake down the fruit. He did not report the incident at the time through fear of punishment for his poaching.

A case of gunshot wound of the face is reported by Schmidt.[215] The patient was a 16-year-old boy who was wounded by the accidental discharge of a pistol. After the swelling in the cheek subsided a draining fistula remainded, and nothing was done for several months. Finally an x-ray picture showed a bullet in the antrum. When exposed via a sublabial incision it was found impacted, the point resting on the floor of the sinus and the heel perforating the floor of the orbit near the infraorbital foramen. It was necessary to resect part of the frontal process of the maxilla before the bullet could be dislodged. Considerable discharge and granulation tissue was present in the periorbita. However, the healing was prompt.

Mittermaier [216] points out, first of all, the difficulty of obtaining satisfactory x-ray films in cases of frontobasal trauma when the patient is unruly or semiconscious. He insists on several projections, since a fracture may be visualized only in one plane and not be seen in the others. He also emphasizes the importance of selecting the proper time for performing an operation on the traumatized sinus and brain, even when a meningitis is present. Two cases are cited where severe hemorrhage ensued during the operation, necessitating tamponade, and both cases ended fatally. The hemorrhage was attributed to the unstable condition of the patients, who were both operated on during their menstrual periods. Most cases can be controlled for the time being by antibiotics until such time as the general condition of the patient is more favorable.

The author warns against too many lumbar punctures in these cases. He says they should be discontinued as soon as the symptoms begin to subside, i. e., the temperature, fluid pressure, and general conditions of the patient. He has found that from two to four punctures were all that were required. Also the intrathecal injections of penicillin may cause damage if carried too far. These should be stopped if the cell count falls below 1000.

As for the surgical intervention, he states that trauma to the dura and brain requires varying types of technique according to the degree of damage. In dealing with the sinus, the author is inclined to be as conservative as possible and says that to define "as radical as indicated or as conservative as indicated" is very difficult. If it is necessary to support a repaired lacerated dura by applying the skin of the sinus area over it, one would have to obliterate that portion of the sinus. Yet it would still be possible to maintain a functioning portion if in continuity with the nasal cavity.

Brandenburg and Maurer [217] report a case in which intensive x-ray therapy had been employed for a carcinoma of the ethmoid. Surgery and a second course of irradiation was given. The patient suddenly developed symptoms of disturbed consciousness and died of severe pneumonia. Autopsy revealed extensive necrosis of brain substance in the frontal lobes with a deep crater-like necrosis of both gray and white matter over the sequestrating roof of the orbit.

This damage is explained as due to direct trauma to the ganglion cells and injury to the blood vessels, particularly affecting the endothelium.

Malecki [218] demonstrated a stereoradiographic technique very similar to the Rheese projection for the diagnosis of fractures of the base in the anterior fossa. He emphasizes the importance of collaboration between the neurosurgeon and the laryngologist, and describes a method of waterproof suturing of the cranial coverings.

According to Bablik,[219] emphysema of the lids and orbit following fractures of the ethmoid are much more frequent than in fractures of the frontal and maxillary sinuses. It was present in all of the 27 cases of fractures of the ethmoid and in only 2 cases was it found as a result of frontal or maxillary fractures. It is explained on the basis of the difference in the density of the bones involved. The frontal and maxillary bones are dense, whereas the ethmoid is fragile. In the former, the fragments maintain contact with each other, thus preventing the escape of air, whereas in the case of ethmoid fractures the thin bone shatters and the fragments, being attached to firm periosteum or mucosa, become movable when differences in air pressure arise within the nose.

Heinze [220] reports a serious cerebral complication following an attempted frontal sinus irrigation. Passage of the cannula was difficult. Some force was applied and irrigation attempted. This proved very painful and caused some dizziness. Shortly thereafter the patient vomited and became unconscious. X-rays revealed an area of pneumocephalus in the frontal lobe measuring 3 by 4 cm. and extending backward for a distance of 5 to 6 cm. Fluid was also apparent just below. There was a slight meningeal reaction.

The area was exposed by removing the floor and anterior wall of the frontal sinus. A small hole surrounded by splintered bone was found in the floor of the sinus medially at the border between the frontal and ethmoid, which led into the interior of the brain. The air and fluid were evacuated by aspiration and the space filled with penicillin solution. Cultures from the fluid showed a hemolytic Staphylococcus aureus and Staphylococcus pyogenes albus.

The patient recovered after two weeks of combined intrathecal and intravenous antibiotic therapy.

Hühnermann [221] states that trauma involving the frontal sinus does not necessarily imply that the anterior wall of the sinus must be removed. He advises opening the sinus through the floor near the internal angle, removing all bone splinters and foreign bodies, removing all the mucosa, and providing wide drainage into the nose, maintaining the passage with an indwelling rubber tube as recommended by Seiffert.

Perforating wounds through the frontal sinus often deemed harmless may prove very serious, since one may not be able at once to determine the depth of the penetration. In all of these cases he advises wide exposure of the dura and treatment of the dural and brain injury by accepted neurosurgical procedures. Close collaboration between the neurosurgeon and the otolaryngologist is advisable.

Bauer [222] demonstrates a plastic prosthesis which he has used successfully in building up defects of the frontal bone resulting from previous widespread trauma. The material is shaped from a plaster model of the patient and is lightened by numerous burr holes drilled into its substance. It is

inserted under the skin through an incision either at the hair line or through a natural fold in the supraorbital skin of the forehead.

The prosthesis mentioned above is also reported in another article, by Bauer and Langegger.[223]

Becker[224] has successfully closed dural lacerations in nine cases by simply filling the defect with fibrin sponge (Fibrospum) and closing the soft tissues over it completely. Experiments on dogs with induced lesions simulating trauma as sustained by humans revealed what happens to this material. It is shown that at first the mass is infiltrated with polynuclear leukocytes. This is followed by invasion of giant cells, fibrocytes, and fibroblasts, with resorption of the implanted material and the formation of scar tissue which effectively heals the breach.

Mundnich[225] states that blunt trauma to the skull in the frontal region without external laceration can cause severe brain damage through localized capillary hemorrhages with subsequent softening of brain substance and infection. All this may occur without demonstrable laceration of the dura. Since the infection must arise from the sinuses, it is important in such cases to guard against this possibility by exposing the sinus for drainage. Otherwise, the patient must be under constant observation because the danger of infection is ever present, especially in the course of an acute upper respiratory episode.

Kindler[226] selected 21 cases out of several hundred perforating wounds of the frontal area seen during World War II for analysis because they were continuously observed over a stated period of time. The perforating agents included grenade splinters, mine fragments, shrapnel shell fragments, and pistol bullets.

There were three cases of frontal lobe abscess with meningitis, one case of intra-arachnoid hemorrhage, and three cases of purulent meningitis communicating with infected frontals and ethmoids via fracture lines. In the other 14 cases there were no intracranial complications and no fatalities. The good results were attributed to early surgical intervention and the use of sulfonamides. Cultures in these cases showed hemolytic streptococci in four and hemolytic staphylococci in six. Mixed infections were the rule.

Theissing[227] emphasizes the importance of early surgical intervention in cases of blunt trauma to the frontal area because of the danger of late intracranial complications. He cites seven cases observed in his clinic in recent years, in three of which a sinus infection complicated skull fractures in the anterior fossa. In these instances the meningitis did not supervene until months later. Surgery at this time revealed old unhealed fractures involving the frontal and ethmoid sinuses with dural lacerations and direct communication between the sinus and endocranium.

The diagnosis of the extent of the damage to the bony structures about the sinuses is not always easy, and the author urges the use of stereographs and planigraphs in all these cases. Frequently fractures on the side opposite the site of the trauma are overlooked, leading to trouble at a later date. This is because of the difficulty of demonstrating splintering of the thin bones of the orbital roof and cribriform area.

Wessely[228] cites three cases of delayed intracranial complications following frontobasal trauma. In one case the x-ray pictures at the time of the accident failed to reveal any fracture. Yet, two weeks later when meningeal symptoms developed, the operation disclosed fractures of the floor of the orbit, the posterior wall of the frontal sinus, and a splinter of bone penetrating into the substance of the brain. In another case the injury seemed trivial and apparently the patient was not hospitalized. Two weeks later, after an acute rhinitis, the patient became comatose. She was promptly operated upon, at which time extensive fractures of the frontal bone were found as well as an epidural abscess. A lethal meningitis supervened. In another case, a child of 7 was

accidently stabbed in the region of the upper lid by a common pencil. The superficial wound was taken care of, and nothing further was done until three weeks later, when the child began manifesting psychiatric phenomena. Meningitis developed. The sinuses were cloudy. The area was opened up and a piece of the pencil was recovered from the ethmofrontal region. Further exposure revealed a frontal lobe abscess. Despite previous negative x-ray findings, the operation demonstrated extensive fracture lines in the ethmoid and frontal bones without any displacement.

Loebell [229] reports a case of osteomyelitis of the frontal bone which developed several years after a fracture sustained during the war. Aside from primary wound closure nothing was done, and the man developed a sinus infection which was operated upon several times. When seen by the author he was still suffering from a frontal sinusitis and the x-ray pictures showed bone involvement with erosion. The diseased bone was removed in a Riedel type of operation with complete obliteration of the frontals. The antrums were also cleaned out via a Caldwell-Luc operation.

Schlosshauer and Vosteen [230] report two cases of fatal hemorrhage from the internal carotid artery resulting from fractures of the sphenoid bone. In both cases there were recurring massive hemorrhages from the nose. X-ray pictures in the first case clearly demonstrated the fracture through the sphenoid and anterior clinoid process, and an arteriogram revealed a narrowing of the artery near the first bend. The laceration of the vessel and the extensive fractures through the base were found at autopsy.

In the second case an aneurysm was outlined by the arteriogram and an attempt was made to control the bleeding by tying the internal carotid in the neck, but this procedure was followed by a hemiplegia within seven hours. The ligature was loosened, but the massive hemorrhages recurred; they could not be controlled by tamponade, and the patient died.

Irby and Gavin [231] have rigged up an apparatus for the treatment of maxillofacial injuries which does away with the cumbersome plaster-of-Paris head cast. Anchorage is provided below the mandibular and occipital area by means of a Forrester collar, to which the wire scaffolding is attached. "The various segments were connected by means of Roger Anderson clamps—four large brass clamps similar in design to the single unit Roger Anderson attachment were fitted to the four posts of the Forrester collar." An illustration shows the apparatus applied to a patient with a depressed fracture of both zygomas and maxillae and a comminuted fracture of the mandible which required an open reduction.

Helsham [232] describes a case in which a 42 mm. block needle, employed for a maxillary block, broke off at the hub and disappeared into the tissues. It was localized by x-rays taken in two planes and was shown to be advanced almost to the foramen ovale, the butt appearing to be above and posterolateral to the bony tuberosity. An incision was made at the height of the buccal sulcus from the first molar region to the tuberosity and continued ½ in. vertically downward immediately lateral to the pterygomandibular raphe. Fat which presented in the wound was removed to afford better visualization and blunt dissection was carried out up to the posterolateral surface of the maxilla. The needle was exposed and removed.

Werner [233] describes a method of implanting an acrylic prosthesis to overcome a frontal defect following extensive compound fractures through the frontal sinuses. Two cases are illustrated in which the open fractures involved both anterior and posterior walls of the sinus with laceration into the dura. The latter was repaired by suture and covered with fascia lata. A second operation was performed in which a coronal incision with reflection of the flap downward exposed the deformed area. Another strip of fascia lata was sewn over the repaired dura to close it off from the nasal duct and the cavity filled with the acrylic process, over which the skin flap was then

drawn and sutured in place. The details of the operative procedure are well shown in the diagrams.

The detailed history of the case reported by Dinçer [234] merely reveals the danger of ignoring pertinent symptoms and delaying operative intervention until it is too late. This patient suffered a blow over the head, with evidences of a basal fracture as demonstrated in the x-ray films, cerebrospinal rhinorrhea, and symptoms of intracranial damage; yet he was shifted from one institution to another until more than a month had elapsed, during which time he was given only palliative treatment. The patient died in coma 47 days after the accident, at about the time when he was scheduled for surgery.

Kruger [235] sets forth some rules governing the treatment of frontobasilar injuries, particularly with reference to the all-important question as to when to operate. Under no circumstances should one interfere as long as the patient is in shock. If there is no evidence of intracranial hemorrhage, one may wait two days before undertaking primary therapy. This is important because in many cases the patient has to be transported to a center that is properly equipped.

If a fracture cannot be demonstrated even though the symptoms point to it, one is seldom impelled to intervene. Also if a fracture of the base is apparent from the x-rays and the symptoms, one may delay operation provided there is nothing in the history to indicate a previous sinus infection. Otherwise surgery is indicated whether the overlying soft tissues have been traumatized or not.

In one case cited the patient had three episodes of meningitis following trauma with remissions through antibiotics. In this case there was a question as to whether an encephalitis or brain abscess was present. When this was ruled out through ventriculography, the operation was carried out and lacerations of the dura repaired.

In the second case reported by the author, a basal fracture was demonstrated with signs of dural laceration. The operation was performed at once despite absence of external trauma.

The author prefers the coronal incision in these cases for exposure of the entire frontal and orbital area.

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Abstracts from Current Literature

Ear

Further Experience with Antimicrobial Agents in Acute Otitis Media. M. H. Rutherford, Eye, Ear, Nose & Throat Month. 35:571 (Sept.) 1956.

The use of antibiotic drugs, often in insufficient dosage, to arrest the symptoms of acute otitis media has been largely responsible for increasingly poor results in the treatment of this disease. It must be remembered that less than 6% of the patients with acute otitis media had complications in the preantibiotic days. It is this same small group which must be watched closely in the antibiotic era and in which the lack of attention causes the development of a chronic smoldering mastoid infection or the development of scarred and retracted drums, with a loss of hearing.

Acute otitis media must still be considered as a surgical disease. Myringotomy should be performed promptly when the drum is bulging. When used, antibiotic agents are frequently inadequate. The medication must be used in effective dosage and continued for from 7 to 10 days. Parenteral administration of penicillin and streptomycin sulfate in combination is a very effective adjunct to treatment.

Jennes, Waterbury, Conn.

Teacher Judgment of Hearing Loss in Children. Margaret Geyer and Alfred Yankauer, J. Speech & Hearing Disorders 21:482 (Dec.) 1956.

Teacher judgments of hearing loss based upon a check list of symptoms and signs were obtained on 1053 first- and second-grade children in seven schools. All children were screened for hearing loss by individual pure-tone sweep-check testing. Children failing this screening test were threshold-tested and seen by an otologist. Teachers "oversuspected" children to an appreciable extent and failed to suspect 62% of children with a hearing loss. However, the incidence of hearing loss was twice as great in the "teacher-suspected" group as in the "unsuspected" group. No relationships were found between the severity of hearing loss at speech frequencies (except when moderately severe), sex of the child, size of the class, nature of the symptoms or signs, or individual teachers and schools.

Palmer, Wichita, Kan.

Testing the Hearing of the Mentally Retarded. Bernard B. Schlanger and Robert H. Gottsleben, J. Speech & Hearing Disorders 21:487 (Dec.) 1956.

Pure-tone audiometric tests were administered to 498 mentally retarded subjects at The Training School at Vineland, N. J. There was normal hearing in 35%, only slight deviation in 14%, moderate losses in 28%, severe losses in 6%, and deafness in 1%. Seventeen per cent of the population was nontestable, with a mental age below 5 years and personality and social quotients below 40. Four-fifths of this group were either of organic or Mongoloid etiology. The authors discussed the problems of testing a group of this type. A routine hearing examination of all retarded children should be carried out.

Palmer, Wichita, Kan.

A Variation in Technique of Facial Nerve Decompression. Miles L. Lewis Jr., Laryngoscope 66:1451 (Nov.) 1956.

This article is a review of the literature of facial nerve decompression and repair, and of the anatomy involved.

Etiology, pathology, and medical treatment of Bell's palsy are mentioned. Twenty per cent of the cases of Bell's palsy do not recover spontaneously. It is difficult to determine, in the early stages, which patients will. The lessened morbidity of the method presented here may encourage decompression in more cases.

The method consists of antiauricular mastoidectomy with the exposure of the short process of the incus. The posterior canal wall is then trimmed to 1-2 mm., and a hole is drilled through it just below the short process of the incus and just superficial to the horizontal canal. This opening is then enlarged, but a post of bone is left between the opening and the

incus. Through this opening the nerve within the middle-ear cavity can readily be visualized and decompressed. In the cases operated upon, there have been no complications, no loss of hearing, and the convalescent time has been minimal.

HITSCHLER, Philadelphia.

REPAIR OF CHRONIC CENTRAL PERFORATIONS OF THE TYMPANIC MEMBRANE: BY REPEATED ACID CAUTERY; BY SKIN GRAFTING. WILLIAM K. WRIGHT, Laryngoscope 66:1464 (Nov.) 1956.

Grafts from various areas are discussed in this article. It was found that three-fourths thickness grafts from the mastoid area were the most satisfactory. Very light packing is used to keep the graft in place. In a month the patient can be politzerized.

In case the graft does not take, regrafting is usually very successful. It is remarkable that after a year or so these thick grafts become thin, and are almost indistinguishable from a normal drum.

There was a hearing gain of from 10-30 db. in most of the cases. In none was the hearing worse. Some typical cases are cited.

HITSCHLER, Philadelphia.

INVESTIGATION INTO THE DENES-NAUGHTON DIFFERENCE LIMEN TECHNIQUE. E. J. BALLANTYNE, Acta oto-laryng. 46:474 (Nov.-Dec.) 1956.

Some suspicion as to the accuracy of the Denes-Naughton difference limen technique arose when repeated tests on the same persons gave conflicting results. This suggested that the technique might not be suitable for routine examinations. Variables were eliminated by testing normal subjects who did not have recruitment.

The purpose of the Denes-Naughton system is to detect the presence of recruitment by determining the relationship between difference limens measured at levels of different intensities and comparing the result with the normal relationship.

The Denes-Naughton technique was used on 22 normal hearing subjects. Two important facts emerged from the results of this testing: 1. It is possible to obtain a result indicating the presence of recruitment in normal hearing subjects. 2. On retesting the subjects the previous result is not necessarily repeated. A very small margin of experimental error may invalidate the test results. The authors therefore conclude that the Denes-Naughton technique is not a reliable clinical test for the detection of recruitment.

LEWY, Chicago.

Pharynx

THERAPEUTIC INDICATIONS IN CANCER OF THE TONSIL. A. GEGNOUX, PAPILLOU, MONTHARTON, DARGENT, BELOT, REHATTER, & PINET, J. franç. oto-rhino-laryng. 5:505 (Oct.) 1956.

The authors present a study of 474 cases of cancer of the tonsil observed at the Anticancer Clinic of Lyons from 1922 to 1953. Ninety per cent of the cases were epitheliomas. The cases were grouped as follows: (1) where the lesion was limited to a tonsil or a pillar but no larger than 2 cm., (2) more extensive enlargement of the lesion but no frank metastasis, and (3) with either a local, unilateral involvement but no extensive glandular metastasis (classed curative), or a more extensive involvement with either unilateral or bilateral ganglionic metastasis (palliative).

The choice of treatment was usually radiotherapy in large doses, supplemented by the antibiotics. Surgery was indicated in only selected cases and was supplemented by radiation.

Their over-all five-year cure was 26%.

PERSKY, Philadelphia.

Larynx

THE MANAGEMENT OF LINGUAL CANCER. F. E. BERRIDGE and A. G. JAMES, Surg. Gynec. & Obst. 103:595 (Nov.) 1956.

The authors analyze their experience gleaned from 102 consecutive cases of lingual cancer seen at the Ohio State University Medical Center between 1948 and 1956. The predominance of male patients was not as marked as reported by previous investigators. Syphilis appeared to be a significant predisposing factor only for squamous-cell carcinoma arising on the anterior two-thirds of the tongue. The decreasing incidence of syphilis and the increasing tobacco habit in women may mean that oral hygiene and smoking, rather than syphilis, are playing a more decisive role in the predisposition for cancer of the tongue.

Cancer of the tongue may be considered as two different diseases, depending on whether it arises anterior or posterior to the circumvallate papillae. Carcinomas of the anterior of the tongue are nearly exclusively squamous-cell types and are usually located on the lateral margin. The initial symptoms are invariably attributed to the growth itself, thus affording an early detection of the lesion. Despite this, approximately one-fourth of such patients had palpable cervical nodes on admission. By contrast, cancer of the posterior third of the tongue causes symptoms attributable to direct extension of the primary tumor or to metastatic spread. When eventually discovered, the primary lesions were usually large, and palpable cervical lymph nodes were evident on admission in 54% of patients with cancer of the base of the tongue.

The authors feel that surgical treatment of lingual cancer is most uniformly successful. When there is no palpable evidence of lymphatic metastasis, the primary tongue tumor can be excised with relative ease and little inconvenience to the patient. More extensive dissection is required in the presence of mandibular, cervical, or epiglottic involvement. Interstitial irradiation is employed in the form of radioactive iridium seeds loaded into hollow nylon threads. External radiation therapy is employed chiefly as an adjunct to interstitial irradiation. No analysis of end-results is presented. The over-all operative mortality was 2.5%.

FRIEDBERG, Chicago.

Nose

SYMPOSIUM ON RHINOPLASTY: INTRODUCTORY REMARKS. I. B. GOLDMAN, Eye, Ear, Nose & Throat Month. 35:427 (July) 1956.

The lower lateral cartilages are the most important nasal components from the viewpoint of rhinoplasty. It is the nasal tip which gives the nose its most characteristic aspect. In order to obtain the desired esthetic and functional results in surgery of the nasal tip, each surgeon should have a basic technique which should be varied during the course of each operation to meet existing indications. Certain tips do not lend themselves to satisfactory correction. This is especially true in the case of very thick or very thin skin, in the presence of acne rosacea, and in the case of a short columella. In general, careful excision of excessive cartilaginous bulk is necessary, but without giving the appearance of the so-called surgical "pinched" appearance. Cartilage should be removed but not sacrificed. The esthetic result of tip correction varies with the esthetic views of the surgeon. The surgeon must contemplate not only the immediate but also the ultimate result of his surgical technique.

JENNES, Waterbury, Conn.

CORRECTIVE SURGERY OF THE NASAL TIP. G. FRED, Eye, Ear, Nose & Throat Month. 35:428 (July) 1956.

Fred prefers the basic Safian technique to correct the nasal tip in rhinoplasty. This technique utilizes the marginal incision exposure of the alar cartilage. The unique features which characterize the Safian technique include the following: The septocolumellar sutures are tied before the tip is modeled. The cartilage-splitting incision at the angle is performed with a No. 15 Bard-Parker blade, without the use of a guide, and carried out with exactitude and precision. The lateral crus is freed from the overlying skin of the tip but not from the underlying vestibular skin. The lateral crura are then rotated in a forward and outward direction beyond the rim of the nostril so that a small part of each crus protrudes outside the nose. This portion is excised bilaterally. A narrow vertical crescent of cartilage from the medial portion of each rotated lateral crus is then excised. By rotation of both lateral crura and excision of cartilage from the medial and caudal borders of each crus, the direction, size, and shape of the lateral crura are altered and the tip modified.

Fred does not use struts, buttons, or battens. The medial crus is divided into a caudal and a cephalic portion. The latter portion is part of the undesirable dome and is excised later. This cartilage-splitting incision results in a slight dip (which is desirable) in the supratip area. The lateral crura meet the medial crura and do not overlap each other at the midline. If the skin at the tip is thick and heavy, it handicaps the modeling of the tip. Excess fibrous tissue under the skin in this area should be resected in order to render the skin more pliable.

JENNES, Waterbury, Conn.

THE "L" INCISION IN TIP MODELLING (GOLDMAN TECHNIQUE). I. J. FINE, Eye, Ear, Nose & Throat Month. 35:430 (July) 1956.

A technique of remodeling the tip is described which requires minimal sacrifice of the lower lateral cartilage. With the alar marginal incision, the lower lateral cartilage is exposed

and dissected free from the overlying skin. The cartilage is cut at the angle using a grooved director as a guide. The incision passes through both cartilage and vestibular skin. The mesial crura are elevated with dural hooks, and excessive soft tissue between them is excised. They are then reattached with chromic absorbable surgical (gut) sutures. The conjoined mesial crura are trimmed and angled to the desired projection. The lateral crus is grasped with a forceps over the forefinger, the subcutaneous tissue overlying the cartilage is removed, and an L-shaped incision is made in the cartilage. The long arm of the L is parallel to the intercartilaginous incision, and the short arm of the L is parallel to the incision separating the lower lateral cartilage into lateral and mesial portions. The incisions are made through the cartilage but not through the vestibular skin.

This technique allows molding of the nasal tip with minimal removal of cartilage. By the telescoping effect of the L-incision, the section of cartilage within the L is freed of its attachment to the remainder of the cartilage. The tip is therefore easily modeled and narrowed.

JENNES, Waterbury, Conn.

Miscellaneous

MEDIASTINAL EMPHYSEMA COMPLICATING TRACHEOTOMY AND THYROIDECTOMY. HILTON H. STOTHERS, Laryngoscope 66:1411 (Nov.) 1956.

Air may get into the mediastinum as follows: (1) through a perforation of the trachea, bronchi, or esophagus; (2) by intrusion along the fascial cervical planes; (3) via the interstitial route through a lung to the hilus, and along the perivascular and peribronchial sheaths subsequent to rupture of the alveoli, and (4) via the retroperitoneal space. The author cites eight cases of mediastinal emphysema complicating tracheotomy and three following thyroidectomy. An open neck wound with respiratory obstruction, partial or fairly complete, with negative pressure in the thorax and with increased positive intrabronchial and intra-alveolar pressure favors ingress of air. The surgeon, engrossed in his technique, may be unmindful of the present danger of mediastinal emphysema. In fact, a postoperative roentgenogram may be necessary to establish a positive diagnosis. Some 95 citations from the literature imply that danger from this complication is never entirely absent. The cause cannot be entirely prevented, but the effects may be controlled or surmounted by watchfulness, and prompt and effective management. The complication is infrequently fatal. Air in the tissues of the neck disappears in a week or 10 days. As for the breaking down of alveoli and resultant emphysema, it is assumed they are permanent.

ABSTRACTER'S COMMENT: This essay was offered and accepted as a thesis for admission to the American Laryngological, Rhinological and Otological Society, Inc. It is the result of accurate, scientific observation, plus an intensive study of the reports of other surgeons.

I. W. VOORHEES, New York.

CLIMATE AND ASTHMA. HARRY SWARTZ, New York J. Med. 57:273 (Jan. 15) 1957.

This is the 29th in a series of articles on "Fundamentals of Modern Allergy," edited by Samuel J. Prigal. Dr. Swartz is an allergist affiliated with the Roosevelt Hospital's Institute of Allergy. The asthmatic condition varies greatly from one person to another. Dust, pollens, food, heat, and cold or any combination of these factors may set off "a spell." The consensus among allergists now is that prestorm sudden changes in barometric pressures bring on attacks. Any winds, gentle or violent, may carry deleterious agents, such as smut, chemical fumes, etc. Excessive humidity is often injurious, as is alkalosis, from whatever cause. Fog may be harmful; rain, at least, temporarily washes the air free of damaging agents. While excessive humidity is generally bad for the asthmatic, an excessively dry atmosphere is also injurious. Arizona is a Mecca for many, but "pollinosis is a real problem there." Alkaline desert dusts are harmful. As for the supposed benefit of high altitudes, one is usually above air contamination at lower levels. Climatotherapy should not be the first, but the last, resort in management of asthma. Finding a suitable climate is imperative, but trial and error may be the only way of accomplishing this. Conventional therapy in the usual habitat should not be completely disregarded. A fairly constant climatic temperature, with no sudden rises and falls, is desirable.

ABSTRACTOR'S COMMENT: Perhaps one ought to mention psychosomatic influences along with the climatic. People are heard saying: "Oh, I could never exist in Arizona." But they have not tried it. Prejudice is a powerful factor here as elsewhere. Where to live and how is a perennial question for most of mankind.

I. W. VOORHEES, New York.

DEATH IN THE OPERATING ROOM. (Author's name not given), New York J. Med. 57:277 (Jan. 15) 1957.

This is a case reported before the Clinical Anesthesia Conference, under the chairmanship of Dr. Merel H. Harmel. The author had intended to do a plastic correction of a nasal deformity in a white man, aged 36, who was considered physically normal otherwise. The preliminary work-up had shown nothing notable. It seems to have been efficiently carried out. Secobarbital (Seconal), 100 mg., was administered the night before the operation. At 7 a. m. a second dose, 200 mg., of secobarbital was given. Later, a hypodermic injection of 16 mg. of morphine sulfate was given 90 minutes before operation. At the operating table, 10% cocaine was topically applied within the nose, followed by 30 cc. of 1% procaine, infiltated in the operative area. Minutes later, the man complained of pressure in the head, became cyanotic and pulseless. The chest was opened, revealing no beat of the heart. Cardiac massage was carried out, followed by incision of the pericardium and electric defibrillation, without success. The injection of epinephrine, procainamide (Pronestyl), calcium chloride, and procaine into the heart likewise failed. Autopsy revealed anterior wall infarction, "massive and fresh." No other data are supplied. The surgeon's comment relates to the importance of determining any previous cardiac pathology as well as "monitoring" of blood pressure pulse rate, respiration rate, reflexes, etc. It is not habitual to carry out these measures in patients undering local anesthesia. "Autopsy of all unexpected deaths in the operating room is mandatory."

ABSTRACTOR'S COMMENT: We are not usually prepared sufficiently for casualties in the O. R. Teamwork in resuscitation as urged and taught by P. J. Flagg is not as yet the rule. It should be paramount.

I. W. VOORHEES, New York.

TRAUMATIC CEREBROSPINAL FLUID RHINORRHEA AND OTORRHEA, PNEUMOCEPHALUS, AND MENINGITIS. T. P. MORLEY and R. F. HETHERINGTON, Surg. Gynec. & Obst. 104:88 (Jan.) 1957.

The present large number of head injuries in domestic, industrial, and automobile accidents makes the recognition and treatment of the internal compound skull fracture with dural tear increasingly important. Sixty-five cases are reviewed, in fifty-five of which the dural defect was situated in the anterior cranial fossa, in nine it was related to the petrous portion of the temporal bone, and in one case the dural defect was a combination of both.

The manner in which the dural tears presented in 57 cases was as follows: by cerebrospinal fluid fistula alone in 14 cases, pneumocephalus alone in 7, cerebrospinal fluid fistula plus pneumocephalus in 17, meningitis alone in 6, and by meningitis with or following fistula or pneumocephalus in 13. In the remaining eight cases the tear was discovered at primary débridement of the frontal wound.

With respect to anterior fossa fractures, it was found that the ethmoid cells had the largest share of fractures and the cribriform plate the smallest. The T-shaped mass of bone formed by the crista galli and the cribriform plate is exceedingly strong compared with the surrounding shell-like bone of the air cells, and the plate itself is a tough reticulum of cords of dense bone.

Of the 48 patients in whom a dural defect was found and repaired, 45 showed by the absence of further cerebrospinal fluid leak, pneumocephalus, or meningitis that the repair had been effective. The three remaining patients died.

When undoubted evidence exists of traumatic rupture of the dura in these situations, dural repair should be undertaken. This applies as well to dural tears associated with middle-ear and mastoid fractures as it does to fractures of the anterior fossa. The risk attached to an exploratory craniotomy is slight, but there is a considerable chance of a fulminating meningitis developing sooner or later in the untreated cases.

Repair of torn dura with fascia lata is effective in preventing meningitis and in curing a cerebrospinal fluid fistula or pneumocephalus.

FRIEDBERG, Chicago.

News and Comment

ANNOUNCEMENTS

Home Study Courses in Ophthalmology and Otolaryngology.—The 1957-1958 Home Study Courses in the basic sciences related to ophthalmology and otolaryngology, which are offered as a part of the educational program of the American Academy of Ophthalmology and Otolaryngology, will begin on Sept. 1 and continue for a period of 10 months. Detailed information and application forms can be secured from Dr. William L. Benedict, the executive secretary-treasurer of the Academy, 15 Second St. S. W., Rochester, Minn. Registrations should be completed before Aug. 15.

Contributions of Medical Literature to Korea to be Discontinued.—The American-Korean Foundation and the United States Army Medical Service have announced the discontinuation of their joint project of shipping medical books contributed by individual physicians, medical schools, hospitals, and state and local medical societies to Korea.

Books should not be sent to the Sharpe General Depot in California as in the past, for facilities no longer exist for packing and transshipping to Korea.

In making the announcement, Howard A. Rusk, M.D., President of the American-Korean Foundation, said, "The response of physicians and medical groups throughout the country for our appeal for books for Korean medical schools has been so generous that further contributions are not needed." As a result of this program, Dr. Rusk stated, over 77 tons, valued at $76,000, of medical texts, references, and periodicals have been shipped to Korea for distribution to Korean medical schools.

Books

The Principles and Art of Plastic Surgery. Two volumes, boxed. By Sir Harold Gillies and D. Ralph Millard Jr., with Foreword by Jerome Pierce Webster, M.D., Columbia University College of Physicians and Surgeons. Price, $35.00. Pp. 690, with 2472 illustrations (122 in color). Little, Brown & Company, 34 Beacon St., Boston 6, 1957.

In many respects this is the most extraordinary book that has ever been given to me for review. It is in greater part a visual exhibit, with hundreds of plates, diagrams, and photographs in black and white and in color. The horrors of war wounds of the head and neck are illustrated in such detail that one fairly shudders at "man's inhumanity to man." This is somewhat offset by the wit and humor which crop up unexpectedly and leaven the sorrowful loaf. Such humor, needless to say, is unusual in a scientific work. Moreover, it makes reading of the text highly enjoyable. To paraphrase the radio ads: "After buying it you'll be so glad you did."

No review can do full justice to these two volumes. We can merely be astonished at the enormous amount of detail, research, and "reporting" which is the background of the work. Of course, no one can learn how to do plastic surgery by reading a book, but, per contra, no one can do satisfactory, not to say praiseworthy, reconstruction without reading and studying the basic facts recorded by researchers of vast experience, such as these authors have had. Sir Harold Delf Gillies was born in New Zealand in 1882, of Scottish parentage. He obtained his medical degree from Cambridge University, became a house officer at St. Bartholomew's, and gravitated into OLR surgery. He went to France in the World War I period and worked with the Red Cross; he later returned to England, where he set up the great work of reconstructive surgery which is now known the world over. He was knighted by King George V. Students from every country came to study, observe, and work with him, among them many young American surgeons, who returned to the United States to become practitioners and teachers of plastic surgery.

David Ralph Millard Jr. was born in St. Louis in 1919; he was graduated from Yale and from the Harvard Medical School. In 1948 he went to England to work with Sir Harold. Returning home, he applied what he had learned to hospital instruction in St. Louis and Detroit. Later he was given the job of organizing a department of plastic surgery at Baylor Medical School in Houston, Texas. He became Chief Plastic Surgeon to the Marines in Korea, and was invited to tell of his work as an authority before the First International Congress of Plastic Surgeons, held in Sweden in 1955. Much of his recent work has been done in Florida.

This book required 4 years of preparation, and covers a span of 40 surgical years. The manuscript looked so formidable to publishers that it was rejected by several before Little, Brown & Company accepted it for publication. The theme throughout is "the perpetual battle of Beauty versus Blood supply."

Sir Harold suggests 16 principles as a guide in plastic procedures, of which we shall repeat only a few. First, diagnose before you treat. (This involves a complete study of the patient's general health as well as his local condition.) Will he cooperate? Will his tissues accept "a loan" and heal in? Are there general bodily ills (i. e., diabetes) which would defeat healing? After these facts are determined, formulate a plan and work out a pattern for its administration. Obtain a full record, including a complete history, photographs, diagrams, and pencilled notes. Replace normal tissue in normal position and retain it there. Treat the primary defect first; borrow from Peter to pay Paul, but only when Peter can afford it! All losses must be replaced in kind. Do something positive. Never throw anything away. Never let routine methods govern you. Consult other surgeons. Speed in surgery consists in not doing the same thing twice. After-care is as important as planning. Never do today what you can conscientiously put off until tomorrow. Time is the plastic surgeon's most trenchant critic. It is also his greatest ally.

There is much more, but it cannot be reviewed here. This is the picture book of plastic surgery, to be sure, but the text is replete with wisdom, wit, and humor. It is certain to remain a classic for many years.

Otolaryngology in Five Loose-Leaf Volumes and Desk-Index. Edited by George Morrison Coates, Harry P. Schenck, and M. Valentine Miller. Price, not given. Pp. 3868, with line tones, half tones, and color plates. W. F. Prior Company, Inc., Hagerstown, Md., 1956.

There is no doubt that this is a monumental work compiling recent investigations and studies in the entire field of otolaryngology. It is up to date. Although the 120 contributors are leaders in the field of otolaryngology in America, the work is of world-wide significance, as the references and bibliographical material will testify. Since the loose-leaf system is used, the revisions of the chapters supplied from time to time will make it a medical encyclopedia rather than a textbook, which, as we know, is too soon obsolete.

Included is a separate index with about 5000 references, making it easy for the student to refer to any subject or author. This work should be in every teaching institution, both as a readily available cross reference to recent literature and as a basis for the training of candidates for the American Board of Otolaryngology. As stated in the preface, the courses offered yearly by the instructional schedule of the American Academy of Ophthalmology and Otolaryngology are well covered in this work. For those who wish to keep informed on recent otolaryngological techniques, this encyclopedia offers the latest and the most complete and authoritative opinion in the entire field.

Chemosurgery in Cancer, Gangrene, and Infections. By Frederic E. Mohs, B.Sc., M.D., Department of Surgery, University of Wisconsin Medical School; Research Associate, McArdle Memorial Laboratory for Cancer Research, Madison, Wis. Price, $13.50. Pp. 292, with 224 illustrations. Charles C Thomas, Publisher, 301-327 E. Lawrence Ave., Springfield, Ill., 1956.

This is a report on 20 years' investigation of the use of chemicals applied to the skin surface of the body to limit extension of malignancy, and allow for surgical removal. The involved area is controlled by taking microscopic sections and studying them from time to time to determine delimitation. There are thoroughly documented statistics to show five-year results in a large series of cases. This is a method for the microscopically controlled excision of cancer. Each step of treatment is illustrated by photographs and photomicrographs, in color and in black and white. The technique pertains to surface cancer, which can be subjected to chemical fixation in situ, surgically excised, and examined as frozen sections under the microscope. The author stresses unprecedented reliability based on conservatism. However, it is advisable that no one undertake this method by reading only. Bedside and operating-room observation are of paramount importance, plus the actual performance under the practiced eye of the experienced operator. ENT men will find a vast amount of head and neck material which should be thoroughly studied to get the most out of the presentation.

Oral Cancer and Tumors of the Jaws. By George S. Sharp, M.D., F.A.C.S., F.A.C.R. (Thor.); Weldon K. Bullock, M.D., M.Sc. (Path.), and John W. Hazlett, D.D.S. Price, $15.00. Pp. 561, fully illustrated. The Blakiston Company, 330 W. 42nd St., New York 36, 1956.

Dr. Hayes Martin, in his Foreword to this volume, stresses the patient-doctor relationship at the initial visit, when a diagnosis, at least a tentative one, may be made. This holds true also for the dentist who may observe a "curious area in the mouth." Again, early is the important word, and the diagnostic triad of early medicine should be kept in mind—is it cancer, syphilis or tuberculosis? The many illustrations in black and white serve the text well, and an effort is made throughout to show each disease in its varying stages. At the end of each chapter "Reading References" serve as a bibliography. In a work devoted to lesions of both the soft and hard parts of the mouth and face (sinuses), it seems unusual that no mention is made of tonsil tumors. Carcinoma of the tonsils is by no means rare. Sarcoma is, in fact, sometimes mistaken for quinsy. All the authors are affiliated with the University of Southern California's School of Medicine or Dentistry. The material from which the text was compiled must have been extensive. Since colored photography is so much in favor, and has proved helpful and frequently indispensable to diagnostic interpretation, one assumes that it is not used in this book because of the increased cost its use would have entailed.

Directory of Otolaryngological Societies *

FOREIGN AND INTERNATIONAL

Canadian Otolaryngological Society
(Société Canadienne d'Otolaryngologie)

President: Dr. G. M. T. Hazen, 208 Canada Building, Saskatoon, Sask.
Secretary: Dr. G. A. Henry, 328 Medical Arts Building, Toronto.

Venezuela Otorhinolaryngology Society

President: Dr. Alfredo Celis Pérez.
Secretary: Dr. Jesús Miralles.

International Bronchoesophagological Society

President: Dr. Theodor Hünermann, Düsseldorf.
Secretary: Dr. Chevalier L. Jackson, 3401 N. Broad St., Philadelphia 40.

International College of Surgeons, Section of Ophthalmology and Otolaryngology

President: Dr. Henry M. Scheer, 522 W. End Ave., New York 24.
Secretary: Dr. Louis Savitt, 3402 W. Lawrence Ave., Chicago 25.
Place: Palmer House, Chicago. Time: Sept. 8-12, 1957.

International Congress of Audiology

General Secretary: Dr. H. C. Huizing, 182 Oostersingel, Groningen, Netherlands.
Place: Leyden, Netherlands.

International Course in Paedo-Audiology

General Secretary: Dr. H. C. Huizing, 182 Oostersingel, Groningen, Netherlands.
Place: Groningen, Netherlands.

Pan-American Association of Oto-Rhino-Laryngology and Broncho-Esophagology

President: Dr. José Gros, Havana, Cuba.
Secretary: Dr. Chevalier L. Jackson, 3401 N. Broad St., Philadelphia 40.
Meeting: Sixth Pan-American Congress of Oto-Rhino-Laryngology and Broncho-Esophagology.
Place: Brazil. Time: 1958.

Sixth International Congress of Otolaryngology

President: Dr. Arthur W. Proetz, 3720 Washington Blvd., St. Louis.
General Secretary: Dr. Paul H. Holinger, 700 N. Michigan Ave., Chicago 11.

NATIONAL

American Medical Association, Scientific Assembly, Section on Laryngology, Otology and Rhinology

Chairman: Dr. Gordon D. Hoople, 1100 E. Genesee St., Syracuse, N. Y.
Secretary: Dr. Hugh A. Kuhn, 112 Rimbach St., Hammond, Ind.

American Academy of Ophthalmology and Otolaryngology

President: Dr. Erling W. Hansen, 90 S. Ninth St., Minneapolis.
Executive Secretary-Treasurer: Dr. William L. Benedict, 100-1st Ave. Bldg., Rochester, Minn.

American Board of Otolaryngology

President: Dr. Frederick T. Hill, Professional Building, Waterville, Maine.
Secretary-Treasurer: Dr. Dean M. Lierle, University Hospitals, Iowa City.

* Secretaries of societies are requested to furnish the information necessary to keep this list up to date.

AMERICAN BRONCHO-ESOPHAGOLOGICAL ASSOCIATION

President: Dr. Clarence W. Engler, 2323 Prospect Ave., Cleveland.
Secretary: Dr. F. Johnson Putney, 1719 Rittenhouse Sq., Philadelphia 3.
Place: Fairmont Hotel, San Francisco. Time: May 19-20, 1958.
Place: The Homestead, Hot Springs, Va. Time: March 8-9, 1959.

AMERICAN LARYNGOLOGICAL ASSOCIATION

President: Dr. LeRoy A. Schall, 243 Charles St., Boston 14.
Secretary: Dr. Harry P. Schenck, 326 S. 19th St., Philadelphia 3.
Place: Statler Hotel, Washington, D. C. Time: May 3, 1957.

AMERICAN LARYNGOLOGICAL, RHINOLOGICAL AND OTOLOGICAL SOCIETY, INC.

President: Dr. Percy E. Ireland, 100 College St., Toronto, Canada.
Secretary: Dr. C. Stewart Nash, 700 Medical Arts Bldg., Rochester 7, N. Y.
Place: Mark Hopkins Hotel, San Francisco. Time: May 21-23, 1958.

AMERICAN RHINOLOGIC SOCIETY

President: Dr. Walter E. Loch, 9 Beechdale Rd., Baltimore 10.
Secretary: Dr. Robert M. Hansen, 1735 N. Wheeler Ave., Portland, Ore.
Annual Clinical Session: Illinois Masonic Hospital, Chicago, October, 1957.
Annual Meeting: Palmer House, Chicago, October, 1957.

SECTIONS:

Eastern.—Chairman: Dr. Joseph Sullivan, Toronto, Canada.
Southern.—Chairman: Dr. Mercer G. Lynch, New Orleans.
Middle.—Chairman: Dr. Paul M. Moore, Cleveland.
Western.—Chairman: Dr. Sigurd v. Christierson, San Francisco.

AMERICAN OTOLOGICAL SOCIETY, INC.

President: Dr. John R. Lindsay, 950 E. 59th St., Chicago 37.
Secretary-Treasurer: Dr. Dean M. Lierle, State University of Iowa, Iowa City.
Place: Fairmont Hotel, San Francisco. Time: May 17-18, 1958.
Place: The Homestead, Hot Springs, Va. Time: March 13-14, 1959.

AMERICAN OTORHINOLOGIC SOCIETY FOR THE ADVANCEMENT OF PLASTIC AND RECONSTRUCTIVE SURGERY, INC.

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President: Dr. Irvin J. Fine, 505 New Brunswick Ave., Perth Amboy, N. J.
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AMERICAN SOCIETY OF OPHTHALMOLOGIC AND OTOLARYNGOLOGIC ALLERGY

President: Dr. Sam H. Sanders, 1089 Madison Ave., Memphis 3.
Secretary-Treasurer: Dr. Michael H. Barone, 468 Delaware Ave., Buffalo 2.
Place: Palmer House, Chicago. Time: October, 1957.

OTOSCLEROSIS STUDY GROUP

President: Dr. Joseph A. Sullivan, 174 St. George St., Toronto 5, Canada.
Secretary-Treasurer: Dr. Arthur L. Juers, 611 Brown Building, Louisville.
Place: Palmer House, Chicago. Time: Oct. 12, 1957.

SOCIETY OF MILITARY OTOLARYNGOLOGISTS

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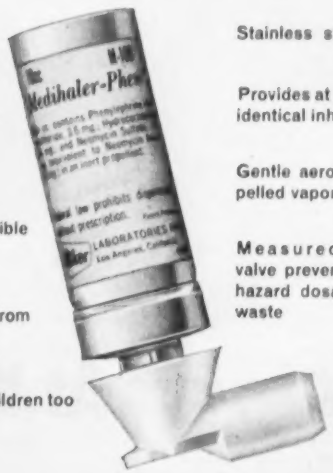

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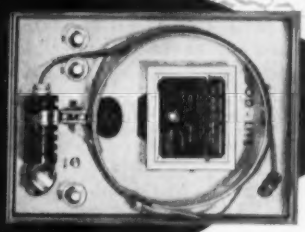

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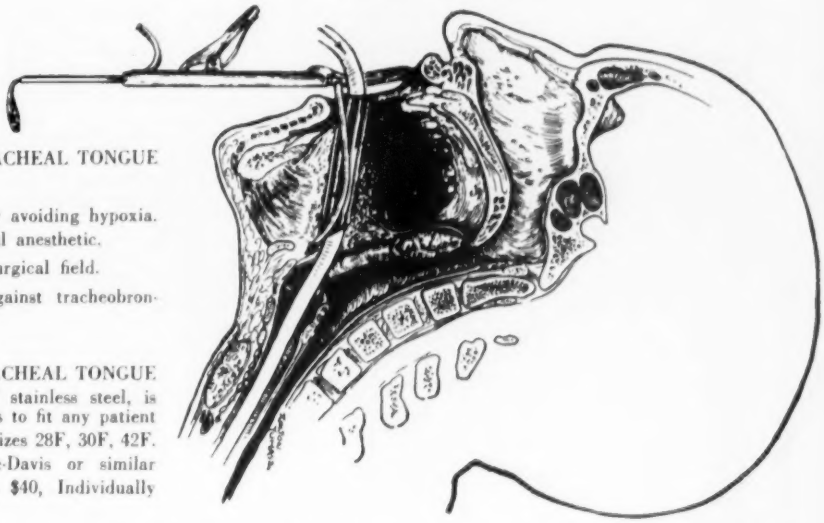

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*Barton, R. T.: Instrument for endotracheal anesthesia during oro-pharyngeal surgery. J. A. M. A. 153:1017 (Nov. 14) 1953.

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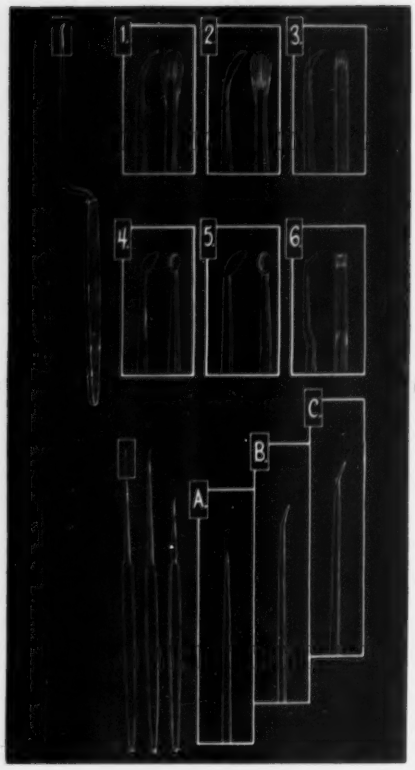

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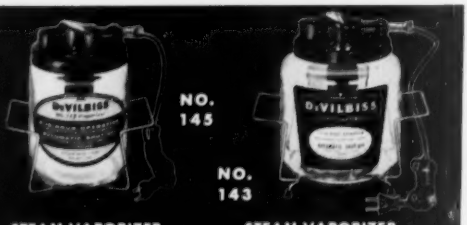

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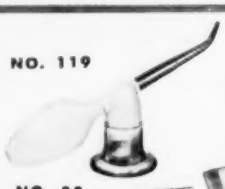

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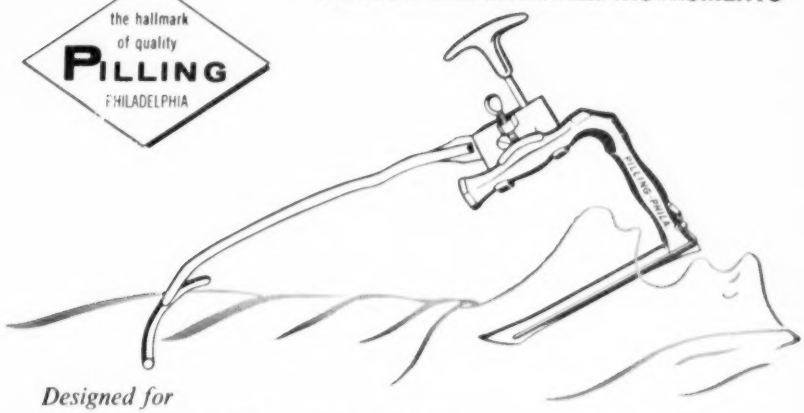

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Reference—R. B. Lewy: Acta Oto-Laryngologica, Vol. 46, Fasc. 1, 1956

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